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Goshen Wind Energy Centre Huron County, Ontario

Final Report

Acoustic Audit Report – Transformer Substation

RWDI # 1500886
May 10, 2016

SUBMITTED TO

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1. INTRODUCTION

RWDI AIR Inc. (RWDI) was retained by Goshen Wind, LP (Goshen Wind) to conduct an Acoustic Audit (emission and immission) of the Goshen Wind Energy Centre transformer substation. The Renewable Energy Approval (REA) for the Goshen Wind Energy Centre (including the transformer), was approved based on the Noise Impact Assessment report (NIA) which was submitted in July 2014.

The intent of this audit is to satisfy Condition E3 of the REA which requires the wind facility to complete an acoustic audit of the Goshen transformer substation. A copy of the facility's REA, number 0558-9GUJ8T dated July 24, 2014, is provided in Appendix A.

The acoustic audit was conducted to meet the requirements of Ministry of the Environment and Climate Change (MOECC) publication NPC-103. This report has been completed following the requirements outlined in MOECC publication NPC-233.

2. FACILITY AND NOISE SOURCE DESCRIPTION

The project is owned by Goshen Wind G.P., ULC, as general partner for and on behalf of Goshen Wind, LP. The Goshen Wind Energy Centre became commercially operational in January 28, 2015.

The Goshen Wind Energy Centre consists of sixty-two General Electric 1.6-100 wind turbine generators, one General Electric 1.56-100 turbine generator and one 115 MVA transformer substation in the project switchyard. The Goshen transformer substation is located near the intersection of Parr Line and Victoria Road, in South Huron County, Ontario. Schematics of the transformer are provided by the operator and are included in Appendix B. A photograph of a similar transformer measurement setup is also included in Appendix B.

The source of concern at the Goshen substation is sound generated from the transformer cooling fans. Noise generated from the transformer body is quite minimal. Based on information provided by the operator, the Goshen transformer substation was estimated to be functioning between 4 to 29% of total load during the audit measurement. Higher transformer load conditions can occur under higher wind speeds, however the cooling fan noise is dominant and does not change with transformer load (i.e., sound level is tied to fan speed). Further, higher ambient wind speeds introduce potential contamination of sound levels due to wind-generated noise at the microphone and provides additional masking of transformer sound from ambient sources (e.g., grass, trees) making source measurements problematic. The assessed condition is considered to be representative of worst-case transformer sound emissions.

Wind speed measurements reported are at ground level conditions. Wind speeds at turbine hub height would generally be higher than those measured at ground level.

3. INSPECTION OF MITIGATION MEASURES

Sound pressure level (SPL) measurements of the transformers were conducted on May 21, 2015. During the site visit, the implementation of the noise control measures described in the NIA Reports were inspected and verified. The general dimensions of the noise barrier surrounding the transformer were observed to conform to the dimension described in Section 4.2 of the July 2014 NIA report, as required in Schedule B of the REA. The barrier is constructed out of high-density plastic filled with an acoustically- absorptive material that is specified to meet the minimum surface density requirements.

4. ACOUSTIC AUDIT PROCEDURE

The acoustic audits (emission and immission) of the transformers were conducted to determine if they are in compliance with the limits specified in the NIA. Measurements were conducted in accordance with the applicable portions of ISO 3744:2010(E), ISO 3746:2010, IEEE C57.12.90-2010 measurement standards and the MOE publication NPC-103 (MOE, 1978). The audit measurements were conducted using Larson-Davis model 824 precision integrating sound level meters. Field calibration checks were conducted before and after the measurements and no drift of concern was noted. Information pertaining to the sound level measurement equipment is provided in Appendix C. Weather conditions observed at ground level during the measurement period are summarized in Appendix D.

4.1 Emission

The emission acoustic audit involved measurements of the transformer in both the ONAN state (cooling fans off) and the ONAF state (cooling fans on). The cooling fans on the transformers were manually turned on and were operational during the duration of the ONAF portion of the audit. Measurements occurred during wind conditions suitable to provide adequate load to the transformers. Measurements were paused for extraneous high-level events such as nearby vehicle traffic and high wind gusts. Transformers were measured at both 1/3 and 2/3 of the total height and at 1 m longitudinal intervals, as per the IEEE C57.12.90-2010 standard. A diagram of the measurement point locations and summaries of the emission sound pressure levels are included in Appendix E.

4.2 Immission

The immission acoustic audit involved measurements to determine the transformer's contribution at nearby sensitive receptors. Location of the nearest sensitive receptor is shown in Figure 1. Spot measurements and objective tonal audibility checks were done by RWDI personnel during the audit at the receptors. No tones were audible at the nearby points of reception during the site visit.



5. ASSESSMENT OF COMPLIANCE

5.1 Emission

The Goshen substation transformer sound power level was determined using the process outlined in the IEEE standard and results are summarized in Table 1 below. Per NPC-103, no tonality was detected at the receptors during the audit. A measured spectrum near the receptor demonstrating this result is shown in Figures 2 and 3 for ONAF and ONAN conditions, respectively. As a result, a tonal penalty was not applied to the calculation or resulting sound power level. The calculated sound power level of the Goshen substation transformer is below the limits outlined in the REA.

Table 1 - Goshen Transformer Substation Sound Power Level

Transformer State	Measured Average Sound Pressure Level (dBA)	Resulting Transformer Sound Power Level (dBA)	REA Guideline Limits (dBA)	Compliance? (Yes/No)
ONAN	65.9	81.2	104.1	Yes
ONAF	71.5	93.6	104.1	Yes

5.2 Immission

The receptor confirmation measurements were conducted close to the fence line of the transformer facility in line with the surrounding point of reception in Figure 1. Measurements at the receptor were not technically feasible due to high ambient sound levels caused by vehicle pass-bys and contributions from nearby turbines. Hence, the sound level at the receptor was determined by extrapolating the measured fence line level to the point of reception (i.e., R1). This extrapolation is anticipated to be conservative as it only accounts for geometric spreading (i.e., distance attenuation). The measurement results for the worst-case receptor during the transformer ONAF condition are summarized in Table 2 below.

Table 2 - Goshen Transformer Substation Receptor Sound Pressure Levels for ONAF

Location	Receptor ID ^[2]	Sound Pressure Level (dBA)	REA Guideline Limits (dBA)	Compliance? (Yes/No)
25 m northeast of the transformer	R1	50.6	-	N/A
At the receptor (815 m northeast of the transformer)	R1	20 ^[1]	40	Yes

[1] Estimated based on distance propagation.

[2] Receptor R1 is identified as receptor "GSH2053" in the NIA report.



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The dominant noise source near receptor R1 (i.e., GSH2053 in the NIA report) is turbine WTG75. Since the estimated transformer contribution at R1 (i.e., 20 dBA) is more than 10 dB lower than the REA limit, the combined sum of the transformer and surrounding turbine sound will meet the REA guideline limit even if the turbine contributions are 40 dBA (i.e., 20 dBA + 40 dBA = 40 dBA).

6. CONCLUSION

This audit report satisfies Condition E3 in the REA for the Goshen Wind Energy Centre. The results of the audit measurements for the transformers at the Goshen Wind Energy Centre indicate that the site is in compliance with the limits listed in the REA.

7. REFERENCES

IEEE Standard C.57.12.90-2010, 2010, *Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers*

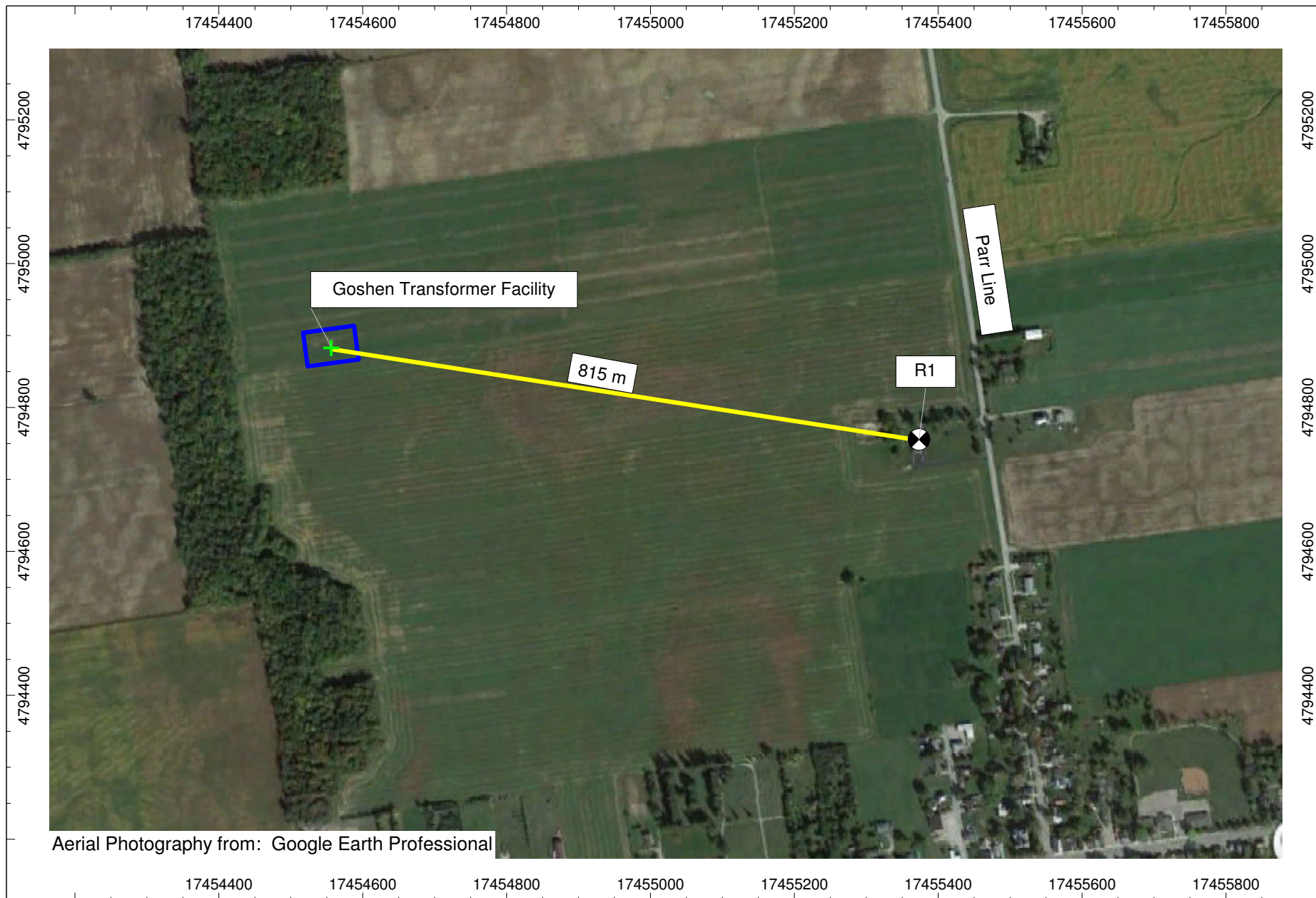
International Organization for Standardization (ISO), 2010, International Standard ISO-3744:2010(E). *Acoustics – Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane*

International Organization for Standardization (ISO), 2010, International Standard ISO-3746:2010(E). *Acoustics – Determination of sound power levels of noise sources using sound pressure. Survey method using an enveloping measurement surface over a reflecting plane*

Ontario Ministry of the Environment (MOE), 1978, *Model Municipal Noise Control Bylaw*, which includes *Publication NPC-103 – Procedures*, and *Publication NPC-104 – Sound Level Adjustments*

Ontario Ministry of the Environment (MOE), 2010, Publication NPC-233, *Information to be Submitted for Approval of Stationary Sources of Sound*

FIGURES



Goshen Transformer Site and Receptor Location

Note: Green "+" is Transformer Location

South Huron County - Ontario

True North

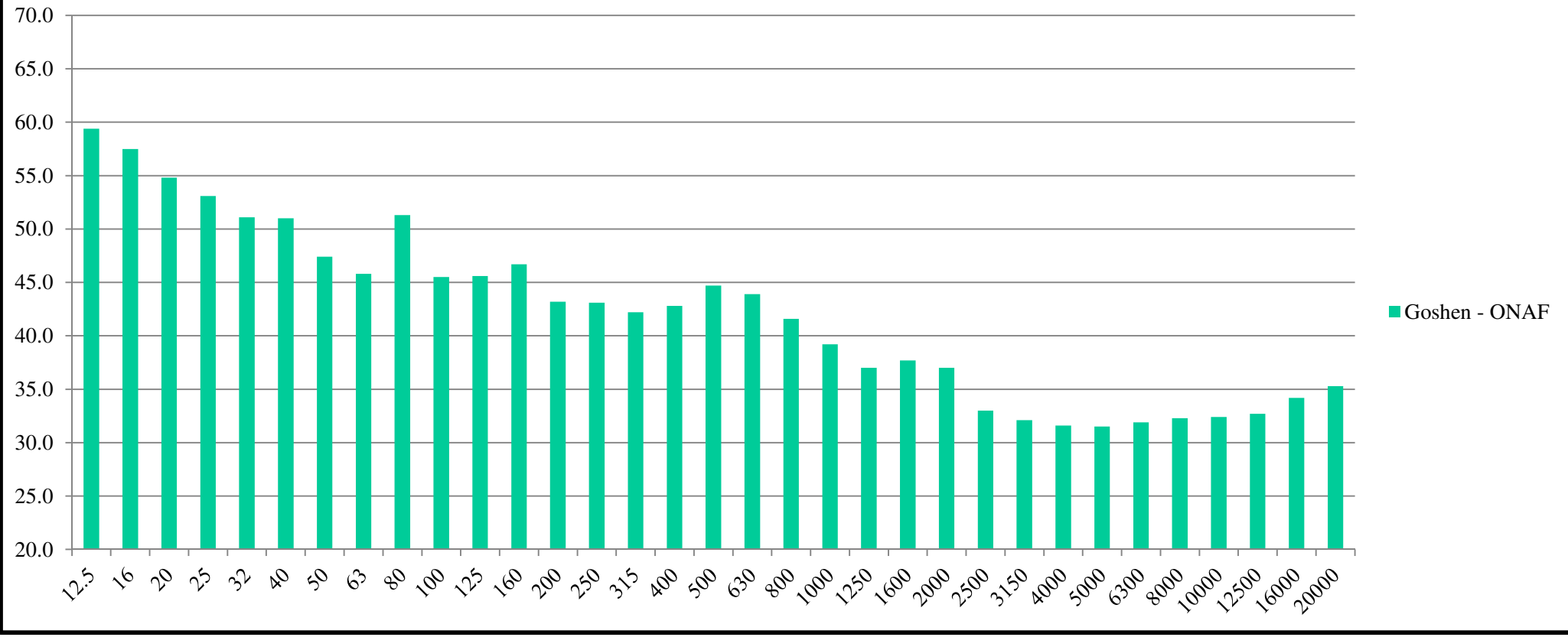


Project #1500886

Drawn by: ELS	Figure: 1
Scale: 1:7500	
Date: May. 28, 2015	



Goshen Transformer



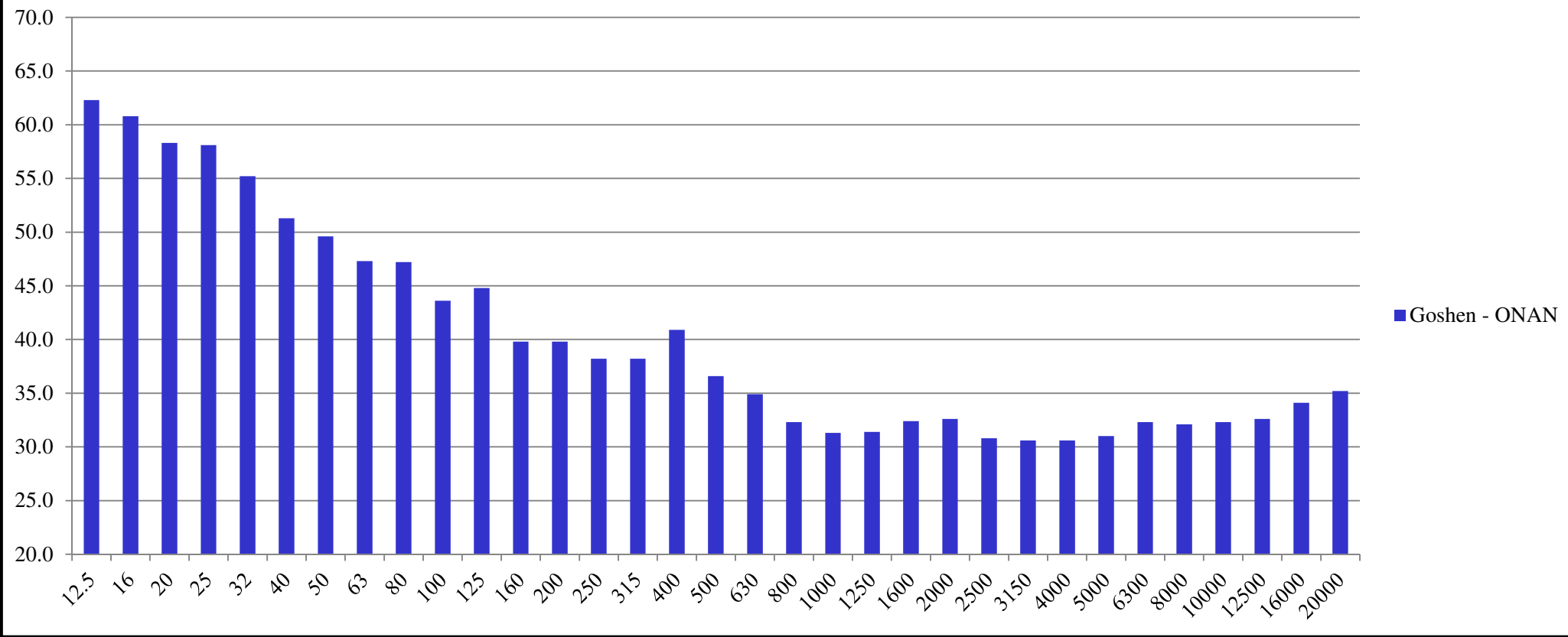
1/3 Octave Measured ONAF Sound Pressure Levels

Drawn by: AKH Figure: 2

Date Revised: Mar 30, 2016



Goshen - ONAN



1/3 Octave Measured ONAN Sound Pressure Levels

Drawn by: AKH Figure: 3

Date Revised: Mar 30, 2016



APPENDIX A

RENEWABLE ENERGY APPROVALNUMBER 0558-9GUJ8T
Issue Date: July 24, 2014

Goshen Wind GP, ULC, as general partner for and on behalf of Goshen Wind, LP
390 Bay Street, Suite 1720
Toronto, Ontario M5H 2Y2

Project: Goshen Wind Energy Centre
Location: Generally bounded by Klondyke Road to the west, Rogerville Road to the north, Parr Line to the east, and Mount Carmel Drive to the south, in Huron County. Transmission line extends eastward and is generally bounded by Parr Line to the west, Thames Road to the north, Perth 164 Road to the east, and Park Road to the south, in Huron County. Municipality of Bluewater, Municipality of South Huron, within Huron County

You have applied in accordance with Section 47.4 of the Environmental Protection Act for approval to engage in a renewable energy project in respect of a Class 4 wind facility consisting of the following:

- the construction, installation, operation, use and retiring of a Class 4 wind facility with a total name plate capacity of 102 megawatts.

For the purpose of this renewable energy approval, the following definitions apply:

1. "Acoustic Assessment Report" means the report included in the Application and entitled Goshen Wind Energy Centre - Revised Noise Assessment Report, dated July 2014, prepared by AECOM and signed by Alex Dundon P.Eng on July 23, 2014;

2. "Acoustic Audit - Emission" means an investigative procedure that is compliant with the IEC Standard 61400-11 and consisting of measurements and/or acoustic modelling of noise emissions produced by wind turbine generators, assessed to determine compliance with the manufacturer's noise (acoustic) equipment specifications and emission data of the wind turbine generators, included in the Acoustic Assessment Report;
3. "Acoustic Audit - Immission" means an investigative procedure consisting of measurements and/or acoustic modelling of all sources of noise emissions due to the operation of the Equipment, assessed to determine compliance with the Noise Performance Limits set out in this Approval;
4. "Acoustic Audit Report-Emission" means a report presenting the results of the Acoustic Audit - Emission;
5. "Acoustic Audit Report-Immission" means a report presenting the results of the Acoustic Audit - Immission;
6. "Acoustic Audit Report - Transformer Substation" means a report presenting the results of the Acoustic Audit - Transformer Substation.
7. "Acoustical Consultant" means a person currently active in the field of environmental acoustics and noise/vibration control, who is knowledgeable about Ministry noise guidelines and procedures and has a combination of formal university education, training and experience necessary to assess noise emissions from wind facilities;
8. "Act" means the *Environmental Protection Act*, R.S.O 1990, c.E.19, as amended;
9. "Adverse Effect" has the same meaning as in the Act;
10. "Application" means the application for a Renewable Energy Approval dated January 15, 2013, and signed by F. Allen Wiley, Goshen Wind, Inc., and all supporting documentation submitted with the application, including amended documentation submitted up to the date this Approval is issued, and as assigned by Goshen Wind, Inc. to Goshen Wind, LP on June 27, 2014;
11. "Approval" means this Renewable Energy Approval issued in accordance with Section 47.4 of the Act, including any schedules to it;
12. "A-weighting" means the frequency weighting characteristic as specified in the International Electrotechnical Commission (IEC) Standard 61672, and intended to approximate the relative sensitivity of the normal human ear to different frequencies (pitches) of sound. It is denoted as "A";
13. "A-weighted Sound Pressure Level" means the Sound Pressure Level modified by application of an A-weighting network. It is measured in decibels, A-weighted, and denoted "dBA";
14. "Class 1 Area" means an area with an acoustical environment typical of a major population centre, where the background sound level is dominated by the activities of people, usually road traffic, often referred to as "urban hum";

15. "Class 2 Area" means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas:
 1. sound levels characteristic of Class 1 during daytime (07:00 to 19:00 or to 23:00 hours);
 2. low evening and night background sound level defined by natural environment and infrequent human activity starting as early as 19:00 hours (19:00 or 23:00 to 07:00 hours);
 3. no clearly audible sound from stationary sources other than from those under impact assessment.
16. "Class 3 Area" means a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as the following:
 1. a small community with less than 1000 population;
 2. agricultural area;
 3. a rural recreational area such as a cottage or a resort area; or
 4. a wilderness area.
17. "Company" means Goshen Wind GP, ULC, as general partner for and on behalf of Goshen Wind, LP, a limited partnership formed under the laws of Ontario, and includes its successors and assignees;
18. "Compliance Protocol for Wind Turbine Noise" means the Ministry document entitled, Compliance Protocol for Wind Turbine Noise, Guideline for Acoustic Assessment and Measurement, PIBS# 8540e;
19. "Decibel" means a dimensionless measure of Sound Level or Sound Pressure Level, denoted as dB;
20. "Director" means a person appointed in writing by the Minister of the Environment pursuant to section 5 of the Act as a Director for the purposes of section 47.5 of the Act;
21. "District Manager" means the District Manager of the appropriate local district office of the Ministry where the Facility is geographically located;
22. "Equipment" means the 63 wind turbine generators and one (1) transformer substation, identified in this Approval and as further described in the Application, to the extent approved by this Approval;
23. "Equivalent Sound Level" is the value of the constant sound level which would result in exposure to the same total A-weighted energy as would the specified time-varying sound, if the constant sound level persisted over an equal time interval. It is denoted L_{eq} and is measured in dB A-weighting (dBA);
24. "Facility" means the renewable energy generation facility, including the Equipment, as described in this Approval and as further described in the Application, to the extent approved by this Approval;

25. "IEC Standard 61400-11" means the International Standard IEC Standard 61400-11, Wind turbine generator systems – Part 11: Acoustic noise measurement techniques, 2006;
26. "Independent Acoustical Consultant" means an Acoustical Consultant who is not representing the Company and was not involved in preparing the Acoustic Assessment Report. The Independent Acoustical Consultant shall not be retained by the Acoustical Consultant involved in the noise impact assessment;
27. "Ministry" means the ministry of the government of Ontario responsible for the Act and includes all officials, employees or other persons acting on its behalf;
28. "Noise Guidelines for Wind Farms" means the Ministry document entitled, "Noise Guidelines for Wind Farms - Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities", dated October 2008;
29. "Noise Receptor" has the same meaning as in O. Reg. 359/09;
30. "Publication NPC-233" means Ministry Publication NPC-233, "Information to be Submitted for Approval of Stationary Sources of Sound", October 1995;
31. "O. Reg. 359/09" means Ontario Regulation 359/09 "Renewable Energy Approvals under Part V.0.1 of the Act" made under the Act;
32. "Point of Reception" has the same meaning as in the Noise Guidelines for Wind Farms and is subject to the same qualifications described in that document;
33. "Sound Level" means the A-weighted Sound Pressure Level;
34. "Sound Level Limit" is the limiting value described in terms of the one hour A-weighted Equivalent Sound Level L_{eq} ;
35. "Sound Power Level" means ten times the logarithm to the base of 10 of the ratio of the sound power (Watts) of a noise source to standard reference power of 10^{-12} Watts;
36. "Sound Pressure" means the instantaneous difference between the actual pressure and the average or barometric pressure at a given location. The unit of measurement is the micro pascal (μPa);
37. "Sound Pressure Level" means twenty times the logarithm to the base 10 of the ratio of the effective pressure (μPa) of a sound to the reference pressure of $20 \mu\text{Pa}$;
38. "UTM" means Universal Transverse Mercator coordinate system.

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

A – GENERAL

A1. The Company shall construct, install, use, operate, maintain and retire the Facility in accordance with the terms and conditions of this Approval and the Application and in accordance with the following schedules attached hereto:

Schedule A - Facility Description

Schedule B - Coordinates of the Equipment and Noise Specifications

A2. Where there is a conflict between a provision of this Approval and any document submitted by the Company, the conditions in this Approval shall take precedence. Where there is a conflict between one or more of the documents submitted by the Company, the document bearing the most recent date shall take precedence.

A3. The Company shall ensure a copy of this Approval is:

(1) accessible, at all times, by Company staff operating the Facility and;

(2) submitted to the clerk of each local municipality and upper-tier municipality in which the Facility is situated.

A4. If the Company has a publicly accessible website, the Company shall ensure that the Approval and the Application are posted on the Company's publicly accessible website within five (5) business days of receiving this Approval.

A5. The Company shall, at least six (6) months prior to the anticipated retirement date of the entire Facility, or part of the Facility, review its Decommissioning Plan Report to ensure that it is still accurate. If the Company determines that the Facility cannot be decommissioned in accordance with the Decommissioning Plan Report, the Company shall provide the Director and District Manager a written description of plans for the decommissioning of the Facility.

A6. The Facility shall be retired in accordance with the Decommissioning Plan Report and any directions provided by the Director or District Manager.

A7. The Company shall provide the District Manager and the Director at least ten (10) days written notice of the following:

(1) the commencement of any construction or installation activities at the project location; and

(2) the commencement of the operation of the Facility.

A8. As described in Schedule A of the Approval the Company shall:

- (1) not construct nor operate more than sixty-three (63) out of the sixty-six (66) wind turbine generators identified in the Schedule B of the Approval; and
- (2) construct and operate the GE 1.56 -100 wind turbine generator at the location with UTM coordinates for the wind turbine generator designated as source ID No. WTG 52.

B – EXPIRY OF APPROVAL

B1. Construction and installation of the Facility must be completed within three (3) years of the later of:

- (1) the date this Approval is issued; or
- (2) if there is a hearing or other litigation in respect of the issuance of this Approval, the date that this hearing or litigation is disposed of, including all appeals.

B2. This Approval ceases to apply in respect of any portion of the Facility not constructed nor installed before the later of the dates identified in Condition B1.

C – NOISE PERFORMANCE LIMITS

C1. The Company shall ensure that:

- (1) the Sound Levels from the Equipment, at the Points of Reception identified in the Acoustic Assessment Report, comply with the Sound Level Limits set in the Noise Guidelines for Wind Farms, as applicable, and specifically as stated in the table below:

Wind Speed (m/s) at 10 m height	4	5	6	7	8	9	10
Sound Level Limits, dBA	40.0	40.0	40.0	43.0	45.0	49.0	51.0

- (2) the Equipment is constructed and installed at either of the following locations:
 - a) at the locations identified in Schedule B of this Approval; or
 - b) at a location that does not vary by more than 10 metres from the locations identified in Schedule B of this Approval and provided that,
 - i) the Equipment will comply with Condition C1 (1); and
 - ii) all setback prohibitions established under O. Reg. 359/09 are complied with.
- (3) the Equipment complies with the noise specifications set out in Schedule B of this Approval.

- C2. If the Company determines that some or all of the Equipment cannot be constructed in accordance with Condition C1 (2), prior to the construction and installation of the Equipment in question, the Company shall apply to the Director for an amendment to the terms and conditions of the Approval.
- C3. Within three (3) months of the completion of the construction of the Facility, the Company shall submit to the Director a written confirmation signed by an individual who has the authority to bind the Company that the UTM coordinates of the “as constructed” Equipment comply with the requirements of Condition C1 (2).

D – CONFIRMATION OF VACANT LOT NOISE RECEPTORS

- D1. The locations identified as vacant lot receptors in the Noise Impact Assessment Table of the Acoustic Assessment Report are specified as Noise Receptors for the purposes of subsection 54 (1.1) of O. Reg. 359/09 and subsection 35 (1.01) of O. Reg. 359/09”.

E – ACOUSTIC AUDIT - IMMISSION

- E1. The Company shall carry out an Acoustic Audit - Immission of the Sound Levels produced by the operation of the Equipment in accordance with the following:
- (1) the acoustic audit measurements shall be undertaken in accordance with Part D of the Compliance Protocol for Wind Turbine Noise;
 - (2) the acoustic audit measurements shall be performed by an Independent Acoustical Consultant on two (2) separate occasions at three (3) different Points of Reception;
 - (3) the Points of Reception shall be selected using the following criteria, subject to the constraints imposed by the location of the Points of Reception with respect to the location of the Equipment:
 - a) the selected Point(s) of Reception should represent the location of the greatest predicted noise impact, i.e., the highest predicted Sound Level(s); and
 - b) the selected Point(s) of Reception should be located in the direction of prevailing winds from the Facility;
- E2. The Company shall submit to the District Manager and the Director an Acoustic Audit Report-Immission, prepared by an Independent Acoustical Consultant, at the following points in time:
- (1) no later than twelve (12) months or such other date as agreed to in writing by the Director, after the commencement of the operation of the Facility for the first of the two (2) acoustic audit measurements at the three (3) Points of Reception; and
 - (2) no later than eighteen (18) months or such other date as agreed to in writing by the Director, after the commencement of the operation of the Facility for the second of the two (2) acoustic audit measurements at the three (3) Points of Reception.

E3. The Company shall carry out an Acoustic Audit - Transformer Substation and shall submit to the District Manager and the Director an Acoustic Audit Report – Transformer Substation prepared by an Independent Acoustical Consultant, in accordance with Ministry Publication NPC-233 no later than six (6) months after the commencement of the operation of the Facility.

F – ACOUSTIC AUDIT- EMISSION

F1. The Company shall carry out an Acoustic Audit - Emission of the acoustic emissions produced by the operation of the wind turbine generators in accordance with the following:

- (1) the acoustic emission measurements shall be undertaken in accordance with the IEC Standard 61400-11;
- (2) the acoustic emission measurements shall be performed by an Independent Acoustical Consultant; and
- (3) the acoustic emission measurements shall be performed on two (2) of the wind turbine generators; one (1) turbine rated at 1.6 megawatts generating output capacity and on one (1) of the wind turbine generators rated at 1.56 megawatts generating output capacity used in the Facility.

F2. The Company shall submit to the District Manager and the Director an Acoustic Audit Report-Emission, prepared in accordance with Section 9 of the CAN/CSA –IEC 61400-11-07 Standard by an Independent Acoustical Consultant, no later than twelve (12) months after the commencement of the operation of the Facility.

F3. In addition to the requirements described in Condition F2, the following items must be included in the compliance summary:

- (1) sound power levels (overall levels and frequency spectra in octave bands for each wind speed) of the wind turbine generators;
- (2) tonal audibility values (for each wind speed) of the wind turbine generators;
- (3) a statement that the wind turbine generators sound power levels, as per F3.1, do not exceed the maximum sound power levels specified in the Schedule B of the Approval; and
- (4) a statement that the wind turbine generators tonal audibility values, as per F3.2, comply with the maximum tonal audibility value noted in the Acoustic Assessment Report.

G – STORMWATER MANAGEMENT

- G1. The Company shall employ best management practices for stormwater management and sediment and erosion control during construction, installation, use, operation, maintenance and retiring of the Facility, as described in the Application.
- G2. Within six (6) months of the completion of the construction of the Facility, the Company shall provide the District Manager with a written description of post-construction stormwater management conditions.

H – WATER TAKING ACTIVITIES

- H1. At each turbine foundation construction site, the Company is authorized to take a maximum of 73,000 litres of water per day, for a maximum of five days, for the purpose of construction dewatering.
- H2. On each day water is taken at a turbine foundation construction site for the purpose of construction dewatering, the Company shall record the date, the volume of water taken on that date, and the rate at which it was taken. The daily volume of water taken shall be measured by a flow meter or estimated based on the rate and duration of pumping. The Company shall keep all records required by this condition current, and shall make these records available for review by the Ministry upon request.
- H3. Sedimentation and erosion control measures, such as straw bales, silt fence barriers, sand bags, and/or turbidity curtains, shall be installed at the site of all construction dewatering activities during the construction phase, and remain until the site has been stabilized. The sedimentation and erosion control measures shall be sufficient to control the volumes of surface runoff. Continuous care shall be taken to properly maintain the sedimentation and erosion control devices.
- H4. The Company shall ensure that any water discharged to the natural environment does not result in scouring, erosion or physical alteration of stream channels or banks and that there is no flooding in the receiving area or water body, downstream water bodies, ditches or properties caused or worsened by this discharge.

I – NATURAL HERITAGE

General

- II. The Company shall implement the Environmental Effects Monitoring Plan for the Goshen Wind Energy Centre, title *Natural Heritage Environmental Effects Monitoring Plan (EEMP) for the Goshen Wind Energy Centre* dated January 2014, and the commitments made in the following reports and included in the Application, and which the Company submitted to the Ministry of Natural Resources in order to comply with O. Reg. 359/09:
 - (1) *Natural Heritage Assessment and Environmental Impact Study Report* dated January 2013 prepared by AECOM

- (2) *Natural Heritage Assessment and Environmental Impact Study Report Addendum* dated January 2013 prepared by AECOM
- (3) *Natural Heritage Assessment and Environmental Impact Study Report Second Addendum* dated October 2013 prepared by AECOM
- (4) *Natural Heritage Assessment and Environmental Impact Study Report Third Addendum* dated November 2013 prepared by AECOM

12. If the Company determines that it must deviate from the Environmental Effects Monitoring Plan or the Environmental Impact Study or Addenda thereto, described in Condition I1, the Company shall contact the Director and the Ministry of Natural Resources, prior to making any changes to the Environmental Effects Monitoring Plan or the Environmental Impact Study or Addenda, and follow any directions provided.

Post Construction Monitoring - Significant Wildlife Habitat

13. The Company shall implement the post-construction monitoring described in the Environmental Effects Monitoring Plan, described in Condition I1, including the following:
- (1) Disturbance Monitoring for Bat Maternity Colony (BMC-189, BMC-229, BMC-249, BMC-326, BMC-342, BMC358, BMC-372, BMC-757).
 - (2) Disturbance Monitoring for Colonially-nesting Bird Breeding Habitat (Tree/Shrub) (CNB-01)
 - (3) Disturbance Monitoring for Amphibian Breeding Habitat (Woodland) (AWO-14, AWO-25, AWO-27, AWO-30, AWO-33, AWO-36)
 - (4) Disturbance Monitoring for Habitat for Bird Species of Conservation Concern (Red-headed Woodpecker) (SCB-03)

Post Construction Monitoring - Birds and Bats

14. The Company shall implement the post-construction bird and bat mortality monitoring described in the Environmental Effects Monitoring Plan, described in Condition I1, at a minimum of 19 constructed turbines. In addition:
- (1) The company shall conduct post construction mortality monitoring as described in the Environmental Effects Monitoring Plan described in I1 to include surveys in April for the habitat described in I3 (2).

Thresholds and Mitigation

15. The Company shall contact the Director and the Ministry of Natural Resources if any of the following bird and bat mortality thresholds, as stated in the Environmental Effects Monitoring Plan for the Goshen Wind Energy Centre described in Condition I1, exceeds:
- (1) 10 bats per turbine per year;
 - (2) 14 birds per turbine per year at individual turbines or turbine groups;
 - (3) 0.2 raptors per turbine per year (all raptors) across the Facility;
 - (4) 0.1 raptors per turbine per year (provincially tracked raptors) across the Facility;
 - (5) 10 or more birds at any one turbine during a single monitoring survey; or
 - (6) 33 or more birds (including raptors) at multiple turbines during a single monitoring survey.
16. If the bat mortality threshold described in Condition I5(1) is exceeded, the Company shall:
- (1) implement operational mitigation measures consistent with those described in the Ministry of Natural Resources publication entitled "*Bats and Bat Habitats: Guidelines for Wind Power Projects*" dated July 2011, or in an amended version of the publication. Such measures shall include some or all of the following:
 - i. increase cut-in speed to 5.5 m/s and/or feather wind turbine blades when wind speeds are below 5.5 m/s between sunset and sunrise, from July 15 to September 30 at all turbines; or
 - (2) implement an additional three (3) years of effectiveness monitoring.
17. If the bat mortality threshold described in Condition I5(1) is exceeded after operational mitigation is implemented in accordance with Condition I6, the Company shall prepare and implement a contingency plan, in consultation with the Director and the Ministry of Natural Resources, to address mitigation actions which shall include additional mitigation and scoped monitoring requirements.
18. If any of the bird mortality thresholds described in Conditions I5(2), I5(3), or I5(4) are exceeded for turbines located within 120m of bird significant wildlife habitat, or if disturbance effects are realized at bird significant wildlife habitat within 120m of turbine(s) while monitoring is being implemented in accordance with Conditions I4, the Company shall implement immediate mitigation actions as described in the Environmental Impact Study and Environmental Effects Monitoring Plan described in Condition I1, and an additional three (3) years of effectiveness monitoring.

19. If any of the bird mortality thresholds described in Conditions I5(2), I5(3), or I5(4) are exceeded for turbines located within 120m of bird significant wildlife habitat, or if disturbance effects are realized at bird significant wildlife habitat within 120m of turbine(s) while monitoring is being implemented in accordance with Conditions I4, the Company shall implement immediate mitigation actions as described in the Environmental Impact Study and Environmental Effects Monitoring Plan described in Condition I1, and an additional three (3) years of effectiveness monitoring.
- I10. If either of the bird mortality thresholds described in Conditions I5(5) or I5(6) are exceeded, the Company shall prepare and implement a contingency plan to address immediate mitigation actions which shall include:
- (1) periodic shut-down of select turbines; or
 - (2) blade feathering at specific times of year; or
 - (3) an alternate plan agreed to between the Company, the Director and the Ministry of Natural Resources.
- I11. If any of the bird mortality thresholds described in Conditions I5(2), I5(3), or I5(4) are exceeded while monitoring is being implemented in accordance with Conditions I8 or I9, or if either of the bird mortality thresholds described in Conditions I5(5) or I5(6) are exceeded after mitigation is implemented in accordance with Condition I10, the Company shall contact the Director and the Ministry of Natural Resources and prepare and implement an appropriate response plan that shall include some or all of the following mitigation measures:
- (1) increased reporting frequency to identify potential threshold exceedance
 - (2) additional behavioural studies to determine factors affecting mortality rates;
 - (3) periodic shut-down of select turbines;
 - (4) blade feathering at specific times of year; or
 - (5) an alternate plan agreed to between the Company and the Ministry of Natural Resources.

Reporting and Review of Results

- I12. The Company shall report, in writing, the results of the post-construction disturbance monitoring described in Conditions I3, to the Director and the Ministry of Natural Resources for three (3) years on an annual basis and within three (3) months of the end of each calendar year in which the monitoring took place.
- I13. The Company shall report, in writing, bird and bat mortality levels to the Director and the Ministry of Natural Resources for three (3) years on an annual basis and within three (3) months of the conclusion of the November mortality monitoring, with the exception of the following:

- (1) if either of the bird mortality thresholds described in Conditions I5(5) or I5(6) are exceeded, the Company shall report the mortality event to the Director and the Ministry of Natural Resources within 48 hours of observation;
- (2) for any and all mortality of species at risk (including a species listed on the Species at Risk in Ontario list as Extirpated, Endangered or Threatened under the provincial *Endangered Species Act, 2007*) that occurs, the Company shall report the mortality to the Ministry of Natural Resources within 24 hours of observation or the next business day;
- (3) if the bat mortality threshold described in Condition I5(1) is exceeded, the Company shall report mortality levels to the Director and the Ministry of Natural Resources for the additional three (3) years of monitoring described in Condition I6, on an annual basis and within three (3) months of the conclusion of the October mortality monitoring for each year;
- (4) if any of the bird mortality thresholds described in Conditions I5(2), I5(3), or I5(4) are exceeded for turbines located within 120m of bird significant wildlife habitat, the Company shall report mortality levels to the Director and the Ministry of Natural Resources for the additional three (3) years of effectiveness monitoring described in Condition I8, on an annual basis and within three (3) months of the conclusion of the November mortality monitoring for each year;
- (5) if any of the bird mortality thresholds described in Conditions I5(2), I5(3), or I5(4) are exceeded for turbines located outside 120 m of bird significant wildlife habitat, the Company shall report mortality levels to the Director and the Ministry of Natural Resources for the additional two (2) years of cause and effects monitoring described in Condition I9, on an annual basis and within three (3) months of the conclusion of the November mortality monitoring for each year; and
- (6) if the Company implements operational mitigation following cause and effects monitoring in accordance with Condition I9, the Company shall report mortality levels to the Director and the Ministry of Natural Resources for the three (3) years of subsequent effectiveness monitoring described in Condition I9, on an annual basis and within three (3) months of the conclusion of the November mortality monitoring for each year.

I14. The Company shall publish the following documents on the Company's website;

- (1) any modifications to the Environmental Effects Monitoring Plan as described in Condition I2 within ten (10) days of submitting the final plan to the Director and the Ministry of Natural Resources;
- (2) summaries of the results of the post-construction disturbance monitoring as described in Condition I12, prepared in consultation with the Director and the Ministry of Natural Resources, within ten (10) days of submitting the final report(s) to the Director and the Ministry of Natural Resources; and

- (3) summaries of the results of the annual bird and bat mortality monitoring as described in Condition I13 with the exception of subsection I13(2), prepared in consultation with the Director and the Ministry of Natural Resources, within ten (10) days of submitting the final report(s) to the Director and the Ministry of Natural Resources.

Additional Post Construction Requirements

- I15. To compensate for the loss of significant woodlands as identified in the Environmental Effects Monitoring Plan, described in Condition II, a new area of woodland will be established that is equal to the area to be cleared (up to 2.6 ha), with the total area to be confirmed through a post-construction site inspection conducted by the Company. Details of the afforestation plan will be prepared in consultation with the Ministry of Natural Resources and shall be submitted to the Ministry of Natural Resources within the first year of operation of the project.

J – ENDANGERED SPECIES ACT REQUIREMENTS

- J1. No construction or installation activities shall be commenced in areas at the project location that support habitat for Bobolink and Eastern Meadowlark until the Company has met all requirements under the Endangered Species Act, 2007.
- J2. The Company shall not commence operation of the Facility prior to receiving a written notice of approval from the Minister of Natural Resources related to any operations mitigation plans submitted by the Company pursuant to paragraph 1 of subsection 23.20(7) of O. Reg. 242/08.
- J3. The Company shall ensure that the mitigation measures contained in the approved mitigation plans described in Condition J2 are implemented during the operation of the Facility, subject to any agreement on alternative mitigation measures between the Company and the Ministry of Natural Resources.

K – SEWAGE WORKS OF THE TRANSFORMER SUBSTATION SPILL CONTAINMENT FACILITY

- K1. The Company shall design and construct a transformer substation oil spill containment facility which meets the following requirements:
 - (1) the spill containment facility serving the transformer substation shall have a minimum volume equal to the volume of transformer oil and lubricants plus the volume equivalent to providing a minimum 24-hour duration, 50-year return storm capacity for the stormwater drainage area around the transformer under normal operating conditions. This containment area shall have:
 - (a) an impervious floor with walls usually of reinforced concrete or impervious plastic liners, sloped toward an outlet / oil control device, allowing for a freeboard of 0.25 metres terminating approximately 0.30 metres above grade to prevent external stormwater flows from entering the facility. The facility shall have a minimum of 300mm layer of crushed stoned (19mm to 38mm in diameter) within, all as needed in accordance to site specific conditions and final design parameters; or

- (b) a permeable floor with impervious plastic walls and around the transformer pad; equipped with subsurface drainage with a minimum 50mm diameter drain installed on a sand layer sloped toward an outlet for sample collection purposes; designed with an oil absorbent material on floor and walls, and allowing for a freeboard of 0.25 metres terminating approximately 0.30 metres above grade to prevent external stormwater flows from entering the facility. The facility's berm shall be designed as needed in accordance to site specific conditions and the facility shall have a minimum 300mm layer of crushed stoned (19mm to 38mm in diameter) on top of the system, as needed in accordance to site specific conditions and final design parameters.
- (2) the spill containment facility shall be equipped with an oil detection system; it also shall have a minimum of two (2) PVC pipes (or equivalent material) 50mm diameter to allow for visual inspection of water accumulation. One pipe has to be installed half way from the transformer pad to the vehicle access route;
- (3) the spill containment facility shall have appropriate sewage appurtenances as necessary, such as but not limited to: sump, oil/grit separator, pumpout manhole, level controllers, floating oil sensors, etc., that allows for batch discharges or direct discharges and for proper implementation of the monitoring program described under Condition K4; and
- (4) the Company shall have a qualified person on-site during construction to ensure that the system is installed in accordance with the approved design and specifications.

K2. The Company shall:

- (1) within six (6) months after the completion of the construction of the transformer substation spill containment facility, provide to the District Manager an engineering report and as-built design drawings of the sewage works for the spill containment facility and any stormwater management works required for it, signed and stamped by an independent Professional Engineer licensed in Ontario and competent in electrical and environmental engineering. The engineering report shall include the following:
 - (a) as-built drawings of the sewage works for the spill containment facility and any stormwater management works required for it;
 - (b) a written report signed by a qualified person confirming the following:
 - (i) on-site supervision during construction
 - (ii) in case of a permeable floor systems: type of oil absorbent material used (for mineral-based transformer oil or vegetable-based transformer oil, make and material's specifications)
 - (ii) use of stormwater best management practices applied to prevent external surface water runoff from entering the spill containment facility, and
 - (iv) confirm adequacy of the installation in accordance with specifications.

- (c) confirmation of the adequacy of the operating procedures and the emergency procedures manuals as it pertains to the installed sewage works.
 - (d) procedures to provide emergency response to the site in the form of pumping and clean-up equipment within 24 hours after an emergency has been identified. Such response shall be provided even under adverse weather conditions to prevent further danger of material loss to the environment.
- (2) as a minimum, the Company shall check the oil detection systems on a monthly basis and create a written record of the inspections;
 - (3) ensure that the effluent is essentially free of floating and settle-able solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen or foam on the receiving waters;
 - (4) immediately identify and clean-up all losses of oil from the transformer;
 - (5) upon identification of oil in the spill containment facility, take immediate action to prevent the further occurrence of such loss;
 - (6) ensure that equipment and material for the containment, clean-up and disposal of oil and materials contaminated with oil are kept within easy access and in good repair for immediate use in the event of:
 - (a) loss of oil from the transformer,
 - (b) a spill within the meaning of Part X of the Act, or
 - (c) the identification of an abnormal amount of oil in the effluent.
 - (7) in the event of finding water accumulation in the PVC pipes at the time of inspection, as per Condition K4, the Company shall: (a) for impervious floors, inspect the sewage appurtenances that allow drainage of the concrete pit; or (b) for permeable systems, replace the oil absorbent material to ensure integrity of the system performance and design objectives.
 - (8) for permeable floor systems, the Company shall only use the type of oil specified in the design, i.e. mineral-based transformer oil or vegetable-based transformer oil. If a change is planned to modify the type of oil, the Company shall also change the type of the oil absorbent material and obtain approval from the Director to amend this Approval before any modification is implemented.

K3. The Company shall design, construct and operate the sewage works such that the concentration of the effluent parameter named in the table below does not exceed the maximum Concentration Objective shown for that parameter in the effluent, and shall comply with the following requirements:

Effluent Parameters	Maximum Concentration Objective
Oil and Grease	15mg/L

- (1) notify the District Manager as soon as reasonably possible of any exceedance of the maximum concentration objective set out in the table above;
- (2) take immediate action to identify the cause of the exceedance; and
- (3) take immediate action to prevent further exceedances.

K4. Upon commencement of the operation of the Facility, the Company shall establish and carry out the following monitoring program for the sewage works:

- (1) the Company shall collect and analyze the required set of samples at the sampling points listed in the table below in accordance with the measurement frequency and sample type specified for the effluent parameter, oil and grease, and create a written record of the monitoring:

Effluent Parameters	Measurement Frequency and Sample Points	Sample Type
Oil and Grease	Quarterly, i.e. four times over a year, relatively evenly spaced having a minimum two (2) of these samples taken within 48 hours after a 10mm rainfall event.	Grab

- (2) in the event of an exceedance of the maximum concentration objective set out in the table in Condition K3, the Company shall:
 - (a) increase the frequency of sampling to once per month, for each month that effluent discharge occurs, and
 - (b) provide the District Manager, on a monthly basis, with copies of the written record created for the monitoring until the District Manager provides written direction that monthly sampling and reporting is no longer required; and
- (3) if over a period of twenty-four (24) months of effluent monitoring under Condition K4, there are no exceedances of the maximum concentration set out in the table for Concentration Objective, the Company may reduce the measurement frequency of effluent monitoring to a frequency as the District Manager may specify in writing, provided that the new specified frequency is never less than annual.

K5. The Company shall comply with the following methods and protocols for any sampling, analysis and recording undertaken in accordance with Condition K4:

- (1) Ministry of the Environment publication "Protocol for the Sampling and Analysis of Industrial/ Municipal Wastewater", January 1999, as amended from time to time by more recently published editions, and
- (2) the publication "Standard Methods for the Examination of Water and Wastewater", 21st edition, 2005, as amended from time to time by more recently published editions.

L – TRAFFIC MANAGEMENT PLANNING

- L1. Within three (3) months of receiving this Approval, the Company shall prepare a Traffic Management Plan and provide it to the Municipality of Bluewater, Municipality of South Huron, and Huron County.
- L2. Within three (3) months of having provided the Traffic Management Plan to the Municipality of Bluewater, Municipality of South Huron, and Huron County, the Company shall make reasonable efforts to enter into a Road Users Agreement with the Municipality of Bluewater, Municipality of South Huron, and Huron County.
- L3. If a Road Users Agreement has not been signed with the Municipality of Bluewater, Municipality of South Huron, and Huron County within three (3) months of having provided the Traffic Management Plan to the Municipality of Bluewater, Municipality of South Huron, and Huron County, the Company shall provide a written explanation to the Director as to why this has not occurred.

M – ENVIRONMENT CANADA

- M1. Prior to operating (turbine blade movement that is feathered in accordance with the manufacturer's specifications is allowed) any of the wind turbines at the Facility, the Company shall, in collaboration with Environment Canada, develop the following:
 - (1) an Exceptional Weather Event Protocol that ensures that the Exeter Radar Station (Weather Radar) continues to provide accurate and reliable forecasts and weather warnings for high risk weather events;
 - (2) a Follow-up Plan; and
 - (3) an Adaptive Management Strategy.
- M2. Prior to operating (turbine blade movement that is feathered in accordance with the manufacturer's specifications is allowed) any of the wind turbines at the Facility, the Company shall enter into and fulfill an Agreement Regarding the Implementation of the Follow-up Plan, the Adaptive Management Strategy and the Exceptional Weather Event Protocol (Agreement) with Environment Canada that will set out the details of the commitments and timelines required for the Exceptional Weather Event Protocol, Follow-up Plan, and Adaptive Management Strategy. The Agreement shall include specifics of the financial assurance to be provided by the Company to ensure the implementation of the agreement.
- M3. The day the first wind turbine is operating (turbine blade movement that is feathered in accordance with the manufacturer's specifications is allowed) at the Facility, the Company shall begin implementing its obligations under the Exceptional Weather Event Protocol and Follow-up Plan described in Condition M1.

- M4. As part of the Follow-Up Plan, the Company shall, in collaboration with Environment Canada:
- (1) develop the measureable objectives and decision making criteria for defining the success of the plan;
 - (2) provide for the development, and subsequently the implementation, of the data interpolation mitigation measure agreed to by the Company and Environment Canada;
 - (3) verify the accuracy of the predicted adverse impacts to the Weather Radar resulting from the commercial operation of the Facility;
 - (4) assess the effectiveness of the data interpolation measure(s) to mitigate the predicted adverse impacts during the commercial operation of the Facility; and
 - (5) monitor the effectiveness of the Weather Radar in order to determine whether any additional mitigation measures are necessary.
- M5. During the implementation of the Follow-Up Plan, should it be determined based on the Follow-Up Plan that the data interpolation mitigation measure(s) do not adequately mitigate the adverse impacts of the Facility so that the Weather Radar can continue to provide accurate and reliable forecasts and weather warnings in accordance with Environment Canada's mandate, the Company shall, in collaboration with Environment Canada, implement the Adaptive Management Strategy, which shall include the following:
- (1) the design and implementation of additional mitigation measures that are reasonably necessary to mitigate any identified adverse impacts to the Weather Radar; and
 - (2) the monitoring and assessment of the effectiveness of these additional mitigation measures.

N – ABORIGINAL CONSULTATION

- N1. During the construction, installation, operation, use and retiring of the Facility, the Company shall:
- (1) create and maintain written records of any communications with Aboriginal communities; and
 - (2) make the written records available for review by the Ministry upon request.
- N2. The Company shall provide the following to interested Aboriginal communities:
- (1) updated project information, including the results of monitoring activities undertaken and copies of additional archaeological assessment reports that may be prepared; and
 - (2) updates on key steps in the construction, installation, operation, use and retirement phases of the Facility, including notice of the commencement of construction activities at the project location.

- N3. If an Aboriginal community requests a meeting to obtain information relating to the construction, installation, operation, use and retiring of the Facility, the Company shall make reasonable efforts to arrange and participate in such a meeting.
- N4. If any archaeological resources of Aboriginal origin are found during the construction of the Facility, the Company shall:
- (1) notify any Aboriginal community considered likely to be interested or which has expressed an interest in such finds; and,
 - (2) if a meeting is requested by an Aboriginal community to discuss the archaeological find(s), make reasonable efforts to arrange and participate in such a meeting.

O – ARCHAEOLOGICAL RESOURCES

- O1. The Company shall implement all of the recommendations, if any, for further archaeological fieldwork and for the protection of archaeological sites found in the consultant archaeologist's report included in the Application, and which the Company submitted to the Ministry of Tourism, Culture and Sport in order to comply with O. Reg. 359/09.
- O2. Should any previously undocumented archaeological resources be discovered, the Company shall:
- (1) cease all alteration of the area in which the resources were discovered immediately;
 - (2) engage a consultant archaeologist to carry out the archaeological fieldwork necessary to further assess the area and to either protect and avoid or excavate any sites in the area in accordance with the *Ontario Heritage Act*, the regulations under that act and the Ministry of Tourism, Culture and Sport's *Standards and Guidelines for Consultant Archaeologists*; and
 - (3) notify the Director as soon as reasonably possible.

P – COMMUNITY LIAISON COMMITTEE

- P1. Within three (3) months of receiving this Approval, the Company shall make reasonable efforts to establish a Community Liaison Committee. The Community Liaison Committee shall be a forum to exchange ideas and share concerns with interested residents and members of the public. The Community Liaison Committee shall be established by:
- (1) publishing a notice in a newspaper with general circulation in each local municipality in which the project location is situated; and
 - (2) posting a notice on the Company's publicly accessible website, if the Company has a website;

to notify members of the public about the proposal for a Community Liaison Committee and invite residents living within a one (1) kilometre radius of the Facility that may have an interest in the Facility to participate on the Community Liaison Committee.

- P2. The Company may invite other members of stakeholders to participate in the Community Liaison Committee, including, but not limited to, local municipalities, local conservation authorities, Aboriginal communities, federal or provincial agencies, and local community groups.
- P3. The Community Liaison Committee shall consist of at least one Company representative who shall attend all meetings.
- P4. The purpose of the Community Liaison Committee shall be to:
- (1) act as a liaison facilitating two way communications between the Company and members of the public with respect to issues relating to the construction, installation, use, operation, maintenance and retirement of the Facility;
 - (2) provide a forum for the Company to provide regular updates on, and to discuss issues or concerns relating to, the construction, installation, use, operation, maintenance and retirement of the Facility with members of the public; and
 - (3) ensure that any issues or concerns resulting from the construction, installation, use, operation, maintenance and retirement of the Facility are discussed and communicated to the Company.
- P5. The Community Liaison Committee shall be deemed to be established on the day the Director is provided with written notice from the Company that representative Community Liaison Committee members have been chosen and a date for a first Community Liaison Committee meeting has been set.
- P6. If a Community Liaison Committee has not been established within three (3) months of receiving this Approval, the Company shall provide a written explanation to the Director as to why this has not occurred.
- P7. The Company shall ensure that the Community Liaison Committee operates for a minimum period of two (2) years from the day it is established. During this two (2) year period, the Company shall ensure that the Community Liaison Committee meets a minimum of two (2) times per year. At the end of this two (2) year period, the Company shall contact the Director to discuss the continued operation of the Community Liaison Committee.
- P8. The Company shall ensure that all Community Liaison Committee meetings are open to the general public.
- P9. The Company shall provide administrative support for the Community Liaison Committee including, at a minimum:
- (1) providing a meeting space for Community Liaison Committee meetings;

- (2) providing access to resources, such as a photocopier, stationery, and office supplies, so that the Community Liaison Committee can:
 - a) prepare and distribute meeting notices;
 - b) record and distribute minutes of each meeting; and
 - c) prepare reports about the Community Liaison Committee's activities.

P10. The Company shall submit any reports of the Community Liaison Committee to the Director and post it on the Company's publicly accessible website, if the Company has a website.

Q – OPERATION AND MAINTENANCE

- Q1. Prior to the commencement of the operation of the Facility, the Company shall prepare a written manual for use by Company staff outlining the operating procedures and a maintenance program for the Equipment that includes as a minimum the following:
- (1) routine operating and maintenance procedures in accordance with good engineering practices and as recommended by the Equipment suppliers;
 - (2) emergency procedures;
 - (3) procedures for any record keeping activities relating to operation and maintenance of the Equipment; and
 - (4) all appropriate measures to minimize noise emissions from the Equipment.
- Q2. The Company shall;
- (1) update, as required, the manual described in Condition Q1; and
 - (2) make the manual described in Condition Q1 available for review by the Ministry upon request.
- Q3. The Company shall ensure that the Facility is operated and maintained in accordance with the Approval and the manual described in Condition Q1.

R – RECORD CREATION AND RETENTION

- R1. The Company shall create written records consisting of the following:
- (1) an operations log summarizing the operation and maintenance activities of the Facility;
 - (2) within the operations log, a summary of routine and Ministry inspections of the Facility; and

- (3) a record of any complaint alleging an Adverse Effect caused by the construction, installation, use, operation, maintenance or retirement of the Facility.

R2. A record described under Condition R1 (3) shall include:

- (1) a description of the complaint that includes as a minimum the following:
 - a) the date and time the complaint was made;
 - b) the name, address and contact information of the person who submitted the complaint;
- (2) a description of each incident to which the complaint relates that includes as a minimum the following:
 - a) the date and time of each incident;
 - b) the duration of each incident;
 - c) the wind speed and wind direction at the time of each incident;
 - d) the ID of the Equipment involved in each incident and its output at the time of each incident;
 - e) the location of the person who submitted the complaint at the time of each incident; and
- (3) a description of the measures taken to address the cause of each incident to which the complaint relates and to prevent a similar occurrence in the future.

R3. The Company shall retain, for a minimum of five (5) years from the date of their creation, all records described in Condition R1, and make these records available for review by the Ministry upon request.

S – NOTIFICATION OF COMPLAINTS

- S1. The Company shall notify the District Manager of each complaint within two (2) business days of the receipt of the complaint.
- S2. The Company shall provide the District Manager with the written records created under Condition R2 within eight (8) business days of the receipt of the complaint.

T – CHANGE OF OWNERSHIP

- T1. The Company shall notify the Director in writing, and forward a copy of the notification to the District Manager, within thirty (30) days of the occurrence of any of the following changes:
 - (1) the ownership of the Facility;

- (2) the operator of the Facility;
- (3) the address of the Company;
- (4) the partners, where the Company is or at any time becomes a partnership and a copy of the most recent declaration filed under the *Business Names Act* , R.S.O. 1990, c.B.17, as amended, shall be included in the notification; and
- (5) the name of the corporation where the Company is or at any time becomes a corporation, other than a municipal corporation, and a copy of the most current information filed under the *Corporations Information Act* , R.S.O. 1990, c. C.39, as amended, shall be included in the notification.

SCHEDULE A

Facility Description

The Facility shall consist of the construction, installation, operation, use and retiring of the following Equipment:

- (a) a total of sixty-two (62) out of the sixty-five (65) General Electric Model GE 1.6-100 wind turbine generators, each rated at 1.6 megawatts generating output capacity, as specified in the Acoustic Assessment Report;
- (b) one (1) General Electric Model GE 1.56 - 100 wind turbine generator rated at 1.56 megawatts generating output capacity;
- (c) the total name plate capacity of up to approximately one hundred and two (102) megawatts, designated as source ID Nos. 2 - 6, 8 - 15, 19 - 23, 31 - 39, 41 - 42, 47 - 50, 52 - 78, 80 - 82, and 84 - 86 , respectively each with a hub height of 80 metres above grade, and sited at the locations shown in Schedule B;
- (d) one (1) transformer substation rated at 115 MVA and sited at the location shown in Schedule B; and
- (e) associated ancillary equipment, systems and technologies including on-site access roads, underground cabling and overhead transmission lines,

all in accordance with the Application.

SCHEDULE B

Coordinates of the Equipment and Noise Specifications

Coordinates of the Equipment are listed below in UTM, Z17-NAD83 projection:

	Source ID	Maximum Sound Power Level (dBA)	Easting (m)	Northing (m)	Source Description
1	Trans	104	454,556	4,794,883	Prolec GE 102/136/170 MVA
2	WTG 02	103	450,520	4,805,782	GE 1.6 - 100 LNTE
3	WTG 03	103	451,051	4,805,361	GE 1.6 - 100 LNTE
4	WTG 04	103	450,524	4,804,972	GE 1.6 - 100 LNTE
5	WTG 05	103	451,300	4,804,616	GE 1.6 - 100 LNTE
6	WTG 06	103	451,203	4,803,770	GE 1.6 - 100 LNTE
7	WTG 08	103	447,071	4,803,417	GE 1.6 - 100 LNTE
8	WTG 09	103	446,830	4,802,090	GE 1.6 - 100 LNTE
9	WTG 10	103	448,722	4,804,602	GE 1.6 - 100 LNTE
10	WTG 11	103	448,568	4,803,670	GE 1.6 - 100 LNTE
11	WTG 12	103	449,241	4,803,328	GE 1.6 - 100 LNTE
12	WTG 13	103	448,911	4,802,237	GE 1.6 - 100 LNTE
13	WTG 14	103	448,875	4,801,624	GE 1.6 - 100 LNTE
14	WTG 15	103	449,226	4,800,450	GE 1.6 - 100 LNTE
15	WTG 19	103	445,549	4,795,811	GE 1.6 - 100 LNTE
16	WTG 20	103	445,679	4,795,219	GE 1.6 - 100 LNTE
17	WTG 21	103	445,847	4,794,126	GE 1.6 - 100 LNTE
18	WTG 22	103	447,530	4,795,721	GE 1.6 - 100 LNTE
19	WTG 23	103	447,843	4,796,331	GE 1.6 - 100 LNTE

	Source ID	Maximum Sound Power Level (dBA)	Easting (m)	Northing (m)	Source Description
20	WTG 31	103	452,335	4,797,930	GE 1.6 - 100 LNTE
21	WTG 32	103	452,553	4,796,971	GE 1.6 - 100 LNTE
22	WTG 33	103	452,366	4,796,399	GE 1.6 - 100 LNTE
23	WTG 34	103	453,108	4,799,573	GE 1.6 - 100 LNTE
24	WTG 35	103	454,089	4,796,605	GE 1.6 - 100 LNTE
25	WTG 36	103	446,196	4,792,203	GE 1.6 - 100 LNTE
26	WTG 37	103	446,287	4,791,638	GE 1.6 - 100 LNTE
27	WTG 38	103	446,167	4,791,042	GE 1.6 - 100 LNTE
28	WTG 39	103	447,984	4,793,710	GE 1.6 - 100 LNTE
29	WTG 41	103	448,895	4,791,606	GE 1.6 - 100 LNTE
30	WTG 42	103	448,990	4,790,737	GE 1.6 - 100 LNTE
31	WTG 47	103	452,425	4,792,588	GE 1.6 - 100 LNTE
32	WTG 48	103	452,825	4,793,244	GE 1.6 - 100 LNTE
33	WTG 49	103	454,586	4,792,838	GE 1.6 - 100 LNTE
34	WTG 50	103	455,040	4,793,271	GE 1.6 - 100 LNTE
35	WTG 52	104	440,156	4,788,373	GE 1.56 - 100
36	WTG 53	103	442,135	4,790,871	GE 1.6 - 100 LNTE
37	WTG 54	103	439,792	4,790,436	GE 1.6 - 100 LNTE
38	WTG 55	103	440,005	4,789,811	GE 1.6 - 100 LNTE
39	WTG 56	103	439,925	4,788,922	GE 1.6 - 100 LNTE
40	WTG 57	103	438,121	4,790,232	GE 1.6 - 100 LNTE
41	WTG 58	103	437,973	4,789,428	GE 1.6 - 100 LNTE
42	WTG 59	103	438,098	4,788,616	GE 1.6 - 100 LNTE
43	WTG 60	103	437,501	4,789,050	GE 1.6 - 100 LNTE
44	WTG 61	103	437,294	4,788,459	GE 1.6 - 100 LNTE
45	WTG 62	103	437,743	4,788,017	GE 1.6 - 100 LNTE
46	WTG 63	103	438,227	4,787,615	GE 1.6 - 100 LNTE

	Source ID	Maximum Sound Power Level (dBA)	Easting (m)	Northing (m)	Source Description
47	WTG 64	103	446,988	4,791,822	GE 1.6 - 100 LNTE
48	WTG 65	103	454,014	4,798,992	GE 1.6 - 100 LNTE
49	WTG 66	103	446,376	4,794,650	GE 1.6 - 100 LNTE
50	WTG 67	103	453,955	4,799,707	GE 1.6 - 100 LNTE
51	WTG 68	103	450,577	4,790,696	GE 1.6 - 100 LNTE
52	WTG 69	103	450,788	4,791,504	GE 1.6 - 100 LNTE
53	WTG 70	103	450,838	4,792,170	GE 1.6 - 100 LNTE
54	WTG 71	103	451,847	4,795,562	GE 1.6 - 100 LNTE
55	WTG 72	103	450,670	4,804,345	GE 1.6 - 100 LNTE
56	WTG 73	103	453,192	4,800,669	GE 1.6 - 100 LNTE
57	WTG 74	103	453,886	4,795,484	GE 1.6 - 100 LNTE
58	WTG 75	103	454,731	4,795,014	GE 1.6 - 100 LNTE
59	WTG 76	103	454,137	4,793,736	GE 1.6 - 100 LNTE
60	WTG 77	103	453,186	4,791,237	GE 1.6 - 100 LNTE
61	WTG 78	103	447,027	4,790,721	GE 1.6 - 100 LNTE
62	WTG 80	103	445,510	4,796,315	GE 1.6 - 100 LNTE
63	WTG 81	103	450,167	4,794,140	GE 1.6 - 100 LNTE
64	WTG 82	103	452,242	4,793,145	GE 1.6 - 100 LNTE
65	WTG 84	103	438,410	4,790,647	GE 1.6 - 100 LNTE
66	WTG 85	103	446,173	4,795,111	GE 1.6 - 100 LNTE
67	WTG 86	103	446,578	4,793,447	GE 1.6 - 100 LNTE

Note: The transformer substation Sound Power Level value in the above table includes the 5 decibel (dB) adjustment for tonality as prescribed in Publication NPC-104.

The reasons for the imposition of these terms and conditions are as follows:

1. Conditions A1, A2 and A8 are included to ensure that the Facility is constructed, installed, used, operated, maintained and retired in the manner in which it was described for review and upon which Approval was granted. These conditions are also included to emphasize the precedence of conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.
2. Conditions A3 and A4 are included to require the Company to provide information to the public and the local municipality.
3. Conditions A5 and A6 are included to ensure that final retirement of the Facility is completed in an aesthetically pleasing manner, in accordance with Ministry standards, and to ensure long-term protection of the health and safety of the public and the environment.
4. Condition A7 is included to require the Company to inform the Ministry of the commencement of activities related to the construction, installation and operation of the Facility.
5. Condition B is intended to limit the time period of the Approval.
6. Condition C1 is included to provide the minimum performance requirement considered necessary to prevent an Adverse Effect resulting from the operation of the Equipment and to ensure that the noise emissions from the Equipment will be in compliance with applicable limits set in the Noise Guidelines for Wind Farms.
7. Conditions A8, C2, C3 and D are included to ensure that the Equipment is constructed, installed, used, operated, maintained and retired in a way that meets the regulatory setback prohibitions set out in O. Reg. 359/09.
8. Conditions E and F are included to require the Company to gather accurate information so that the environmental noise impact and subsequent compliance with the Act, O. Reg. 359/09, the Noise Guidelines for Wind Farms and this Approval can be verified.
9. Conditions G, H, I, J, K and L are included to ensure that the Facility is constructed, installed, used, operated, maintained and retired in a way that does not result in an Adverse Effect or hazard to the natural environment or any persons.
10. Condition M is included to ensure that Environment Canada's Exeter Radar Station can continue to be used to provide accurate and reliable forecasts and weather warnings consistent with Environment Canada's mandate.
11. Condition N is included to ensure continued communication between the Company and interested Aboriginal communities.
12. Condition O is included to protect archaeological resources that may be found at the project location.

13. Condition P is included to ensure continued communication between the Company and the local residents.
14. Condition Q is included to emphasize that the Equipment must be maintained and operated according to a procedure that will result in compliance with the Act, O. Reg. 359/09 and this Approval.
15. Condition R is included to require the Company to keep records and provide information to the Ministry so that compliance with the Act, O. Reg. 359/09 and this Approval can be verified.
16. Condition S is included to ensure that any complaints regarding the construction, installation, use, operation, maintenance or retirement of the Facility are responded to in a timely and efficient manner.
17. Condition T is included to ensure that the Facility is operated under the corporate name which appears on the application form submitted for this Approval and to ensure that the Director is informed of any changes.

NOTICE REGARDING HEARINGS

In accordance with Section 139 of the Environmental Protection Act, within 15 days after the service of this notice, you may by further written notice served upon the Director, the Environmental Review Tribunal and the Environmental Commissioner, require a hearing by the Tribunal.

Section 142 of the Environmental Protection Act provides that the notice requiring the hearing shall state:

1. The portions of the renewable energy approval or each term or condition in the renewable energy approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The signed and dated notice requiring the hearing should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The renewable energy approval number;
6. The date of the renewable energy approval;
7. The name of the Director;
8. The municipality or municipalities within which the project is to be engaged in;

This notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto, Ontario
M5G 1E5

AND

The Environmental Commissioner
1075 Bay Street, 6th Floor
Suite 605
Toronto, Ontario
M5S 2B1

AND

The Director
Section 47.5, *Environmental
Protection Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 314-3717 or www.ert.gov.on.ca**

Under Section 142.1 of the Environmental Protection Act, residents of Ontario may require a hearing by the Environmental Review Tribunal within 15 days after the day on which notice of this decision is published in the Environmental Registry. By accessing the Environmental Registry at www.ebr.gov.on.ca, you can determine when this period ends.

Approval for the above noted renewable energy project is issued to you under Section 47.5 of the Environmental Protection Act subject to the terms and conditions outlined above.

DATED AT TORONTO this 24th day of July, 2014



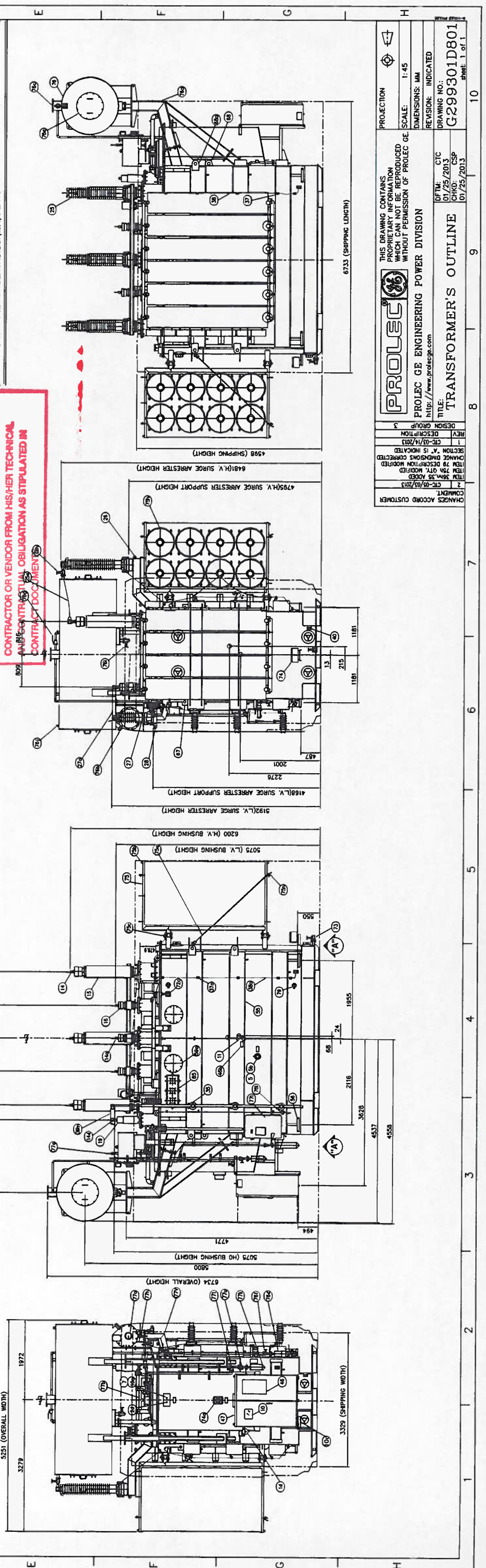
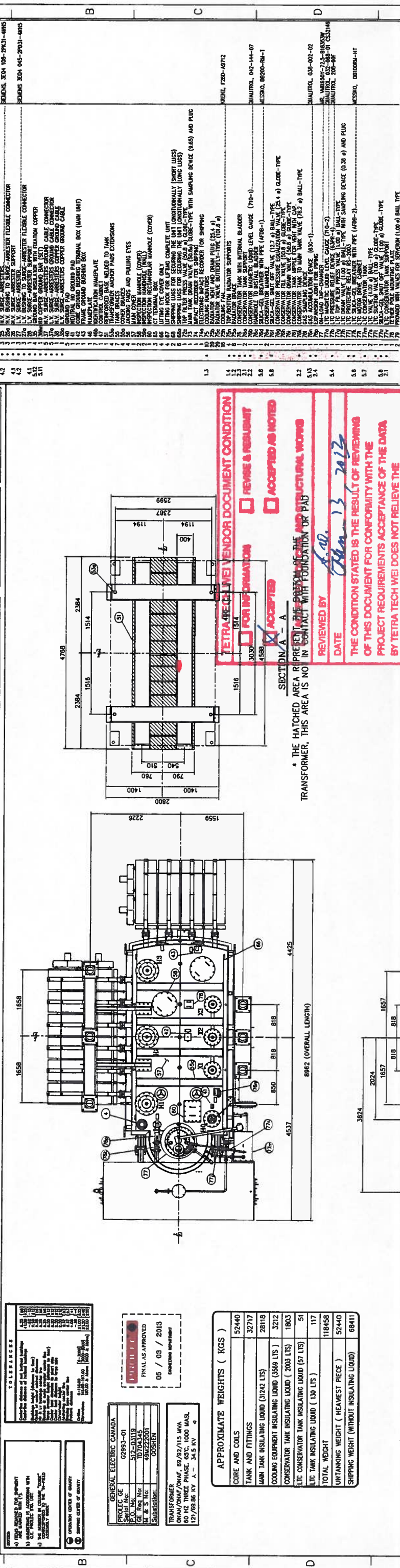
Vic Schroter, P.Eng.
Director
Section 47.5, *Environmental Protection Act*

NC/

c: District Manager, MOE Owen Sound

APPENDIX B

NO	DESCRIPTION	CAT./MOD.
1	MAIN TERMINAL VALVE (M.T.V.)	MAINTROL, 104-65E-03
2	PRESSURE RELIEF VALVE (P.R.V.)	MAINTROL, 200-60F
3	SAFETY VALVE (S.V.)	MAINTROL, 900-003-02
4	TEMPERATURE SENSING DEVICE (T.S.D.)	4PI, EDUPE-008
5	RESISTANCE TEMPERATURE DEVICE (R.T.D.)	MAINTROL, 850-32E
6	RESISTANCE TEMPERATURE DEVICE (R.T.D.)	BRANDY, PROTECTIV
7	RESISTANCE TEMPERATURE DEVICE (R.T.D.)	BRANDY, PROTECTIV
8	RESISTANCE TEMPERATURE DEVICE (R.T.D.)	BRANDY, PROTECTIV
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TETRA TECH WEI VENDOR DOCUMENT CONDITION

FOR INFORMATION

ACCEPTED

REVERSE & RESUBMIT

ACCEPTED AS NOTED

REVIEWED BY: *L. 10.*

DATE: *Jan 13 2013*

THE CONDITION STATED IS THE RESULT OF REVIEWING OF THIS DOCUMENT FOR CONFORMITY WITH THE PROJECT REQUIREMENTS. ACCEPTANCE OF THE DATA BY TETRA TECH WEI DOES NOT RELIEVE THE CONTRACTOR OR VENDOR FROM HIS/HER TECHNICAL OBLIGATION AS STIPULATED IN CONTRACT DOCUMENT.

* THE HATCHED AREA REPRESENTS THE PRESENCE OF THE INS. STRUCTURAL WORKS TRANSFORMER, THIS AREA IS NOT IN CONTACT WITH FOUNDATION OR PAD.

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PROJEC GE ENGINEERING POWER DIVISION

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SCALE: 1:45

DIMENSIONS: MM

REVISION: INDICATED

DRAWING NO: G299301D801

Sheet 1 of 1



APPENDIX C

MEASUREMENT EQUIPMENT



Sound Level Meter 824 Kit 1

Sound Level Meter	
Make and Model	Larson-Davis Model 824 SLM and RTA
Serial No.	824A0450
Pre-amplifier	
Make and Model	Larson-Davis Model PRM902
Serial No.	0836
Microphone	
Make and Model	Larson-Davis Model 2559 precision air-condenser microphone
Serial No.	3020
Calibrator	
Make and Model	Larson-Davis CAL200 precision acoustic calibrator (1000 Hz)
Serial No.	3192

Certificate of Calibration and Conformance

Certificate Number 2013-181568

Instrument Model CAL200, Serial Number 3192, was calibrated on 31OCT2013. The instrument meets factory specifications per Procedure D0001.8190, IEC 60942:2003.

Instrument found to be in calibration as received: YES

Date Calibrated: 31OCT2013

Calibration due: 31OCT2014

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2559	2504	12 Months	03JAN2014	19648-1
PCB	1502B02FJ15PSIA	1342	12 Months	14JAN2014	3441014716
Larson Davis	2900	0661	12 Months	08APR2014	2013-172252
Larson Davis	MTS1000/2201	0111	12 Months	22AUG2014	SM082213
Larson Davis	PRM902	0480	12 Months	23AUG2014	2013-178669
Hewlett Packard	34401A	3146A10352	12 Months	03SEP2014	6214490
Larson Davis	PRM915	0112	12 Months	09OCT2014	2013-180644

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Environmental test conditions as shown on calibration report.

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

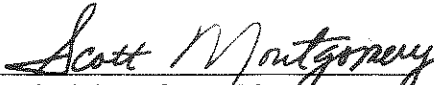
The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

Before: 114.12 dB, 94.14 dB, 1000.0 Hz @ sea level.

After: Refer to Certificate of Measured Output.

Signed:


Technician: Scott Montgomery

Larson Davis CAL200 Acoustic Calibrator, SN: 3192
Certificate of Measured Output

Performance at Reference Conditions

Nominal Level (dB SPL):	94	114
Measured Level (dB SPL):	94.02	114.00
Expanded Uncertainty (dB):	0.137	0.132
Level Error Limit (dB):	±0.34	±0.33
Nominal Frequency (Hz):	1000	1000
Measured Frequency (Hz):	1000.0	1000.0
Expanded Uncertainty (Hz):	0.2	0.2
Frequency Error Limit (Hz):	±10.0	±10.0
Measured Distortion (%):	0.37	0.40
Expanded Uncertainty (%):	0.25	0.25
Distortion Limit (%):	2.0	2.0

The data is acquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity.

Environmental Conditions

Temperature (°C):	25	25
Relative Humidity (%):	27	27
Static Pressure (kPa):	101.4	101.4

Reference Microphone

Model: Larson Davis 2559
Serial Number: 2504
Open Circuit Sensitivity: 11.440 mV/Pascal
Uncertainty: 0.110 dB

Influence of Static Pressure

Nominal Level (dB SPL):	114				
	Nominal Pressure (kPa)	Pressure (kPa)	Level Change (dB)	Frequency Change (Hz)	Distortion (%)
	108.0	108.0	-0.02	-0.00	0.40
	101.3	101.1	0.00	0.00	0.40
	92.0	92.1	0.01	-0.01	0.41
	83.0	83.1	-0.01	-0.01	0.43
	74.0	74.1	-0.08	-0.01	0.45
	65.0	64.9	-0.21	-0.01	0.48
Expanded Uncertainty:		1.0	0.04	0.20	0.25
Limit:			±0.30	±10.0	2.0

Reference microphone corrections applied.

Environmental Conditions

Temperature (°C):	25
Relative Humidity (%):	28

Reference Microphone

Model: Larson Davis 2559
Serial Number: 2504

Static pressure was measured with a calibrated Motorola pressure sensor MPX2100AP.
Temperature and humidity was measured with a calibrated Fluke 1620A sensor.
Expanded uncertainty of environmental measurements: 0.3 °C, 3 %RH, 1.0 kPa
Uncertainty values are given at 95% confidence level (k = 2).

A Sound Level Meter can be calibrated to a level (L) defined as: L = measured level + pressure sensitivity
or if a Sound Level Meter is calibrated using the nominal level, the adjustments to data (X) are defined as:
X = measured level - nominal level - pressure sensitivity

Certificate of Calibration and Conformance

Certificate Number 2013-181649

Microphone Model 2559, Serial Number 3020, was calibrated on 31OCT2013. The microphone meets factory specifications per Test Procedure D0001.8167.

Instrument found to be in calibration as received: YES

Date Calibrated: 31OCT2013

Calibration due: 31OCT2014

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Hewlett Packard	34401A	3146A62099	12 Months	26NOV2013	5884920
Larson Davis	PRM915	0102	12 Months	04DEC2013	2012-167168
Larson Davis	PRM916	0102	12 Months	13DEC2013	2012-167454
Larson Davis	2559	2504	12 Months	03JAN2014	19648-1
Larson Davis	CAL250	42630	12 Months	04JAN2014	2013-168402
Larson Davis	2900	0575	12 Months	24JUL2014	2013-177110
Larson Davis	2559	3034LF	12 Months	13AUG2014	2013-178081
Larson Davis	PRM902	0206	12 Months	15AUG2014	2013-178254
Larson Davis	MTS1000 / 2201	1000 / 0100	12 Months	03SEP2014	SM090313
Larson Davis	PRM902	0529	12 Months	10SEP2014	2013-179249
Larson Davis	PRM902	0528	12 Months	10SEP2014	2013-179248

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"AS RECEIVED" data is the same as shipped data.

Signed: 
Technician: Abraham Ortega

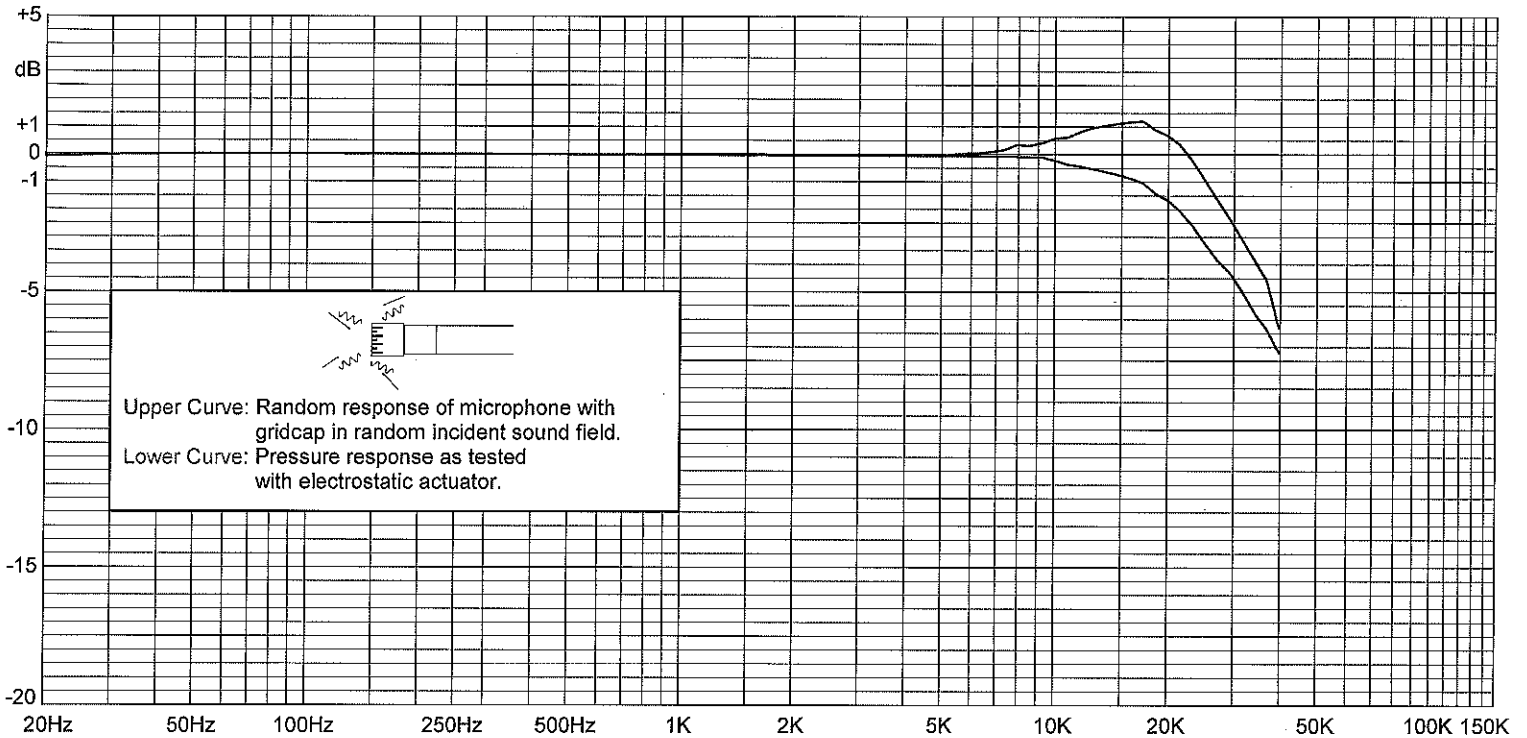


Larson-Davis 1/2" Microphone Calibration Chart

Model: 2559 Serial Number: 3020

Open Circuit Sensitivity @ 1015.4 mbar & 251.19 Hz
 -39.68 dB re 1V/Pascal
 10.37 mV/Pascal
 +13.66 K_o (-dB re 50 mV/Pascal)
Expanded Uncertainty @ ~95% confidence level
 0.18 dB

Capacitance @ 251.2 Hz
 21.7 pF
Test Conditions:
 Polarization Voltage 200 V
 Ambient Pressure 1015.4 mbar
 Temperature 24.5 °C
 Relative Humidity 30.8 %



Frequency Response (0 dB @ 251.19 Hz)
Random and actuator response with reference to level at 251.19 Hz

Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)
19.95	-0.09	-0.09	368.69	-0.01	-0.01	1258.93	-0.04	-0.04	4298.66	-0.04	-0.06	14677.99	1.12	-0.73
25.12	-0.04	-0.04	398.11	-0.01	-0.01	1359.36	-0.04	-0.04	4641.59	-0.03	-0.06	15848.93	1.17	-0.88
31.62	-0.02	-0.02	429.87	-0.01	-0.01	1467.80	-0.04	-0.04	5011.87	-0.02	-0.06	17113.28	1.21	-1.04
39.81	0.00	0.00	464.16	-0.01	-0.01	1584.89	-0.04	-0.04	5411.70	0.00	-0.06	18478.50	0.88	-1.42
50.12	0.01	0.01	501.19	-0.02	-0.02	1711.33	-0.04	-0.04	5843.41	0.04	-0.05	19952.62	0.68	-1.67
63.10	0.01	0.01	541.17	-0.02	-0.02	1847.85	-0.05	-0.05	6309.57	0.04	-0.09	21500.00	0.35	-2.05
79.43	0.01	0.01	584.34	-0.02	-0.02	1995.26	-0.05	-0.05	6812.92	0.10	-0.08	23250.00	-0.23	-2.58
100.00	0.01	0.01	630.96	-0.02	-0.02	2154.43	-0.05	-0.05	7356.42	0.17	-0.08	25000.00	-0.89	-3.19
125.89	0.01	0.01	681.29	-0.02	-0.02	2326.31	-0.04	-0.05	7943.28	0.34	-0.09	27000.00	-1.60	-3.80
158.49	0.01	0.01	735.64	-0.03	-0.03	2511.89	-0.03	-0.04	8576.96	0.31	-0.10	29250.00	-2.33	-4.28
199.53	0.00	0.00	794.33	-0.03	-0.03	2712.27	-0.03	-0.04	9261.19	0.42	-0.10	31500.00	-3.06	-4.94
251.19	0.00	0.00	857.70	-0.03	-0.03	2928.64	-0.04	-0.05	10000.00	0.58	-0.22	34250.00	-3.87	-5.77
271.23	0.00	-0.00	926.12	-0.03	-0.03	3162.28	-0.05	-0.06	10797.75	-0.62	-0.36	36750.00	-4.57	-6.35
292.86	0.00	-0.00	1000.00	-0.03	-0.03	3414.55	-0.04	-0.05	11659.14	0.81	-0.43	39750.00	-6.29	-7.19
316.23	0.00	-0.00	1079.78	-0.03	-0.03	3686.95	-0.03	-0.05	12589.25	0.96	-0.52			
341.45	-0.01	-0.01	1165.91	-0.04	-0.04	3981.07	-0.03	-0.05	13593.56	1.04	-0.63			

Certificate of Calibration and Conformance

Certificate Number 2013-181478

Instrument Model 824, Serial Number A0450, was calibrated on 29OCT2013. The instrument meets factory specifications per Procedure D0001.8046, IEC 61672-1:2002 Class 1; IEC 60651-2001, 60804-2000 and ANSI S1.4-1983 Type 1 1/3, 1/1 Oct. Filters; S1.11-1986 Type 1C; IEC61260-am1-2001 Class 1 .

Instrument found to be in calibration as received: YES

Date Calibrated: 29OCT2013

Calibration due: 29OCT2014

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0617 / 0104	12 Months	16JAN2014	2013-168816

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 23 ° Centigrade

Relative Humidity: 30 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

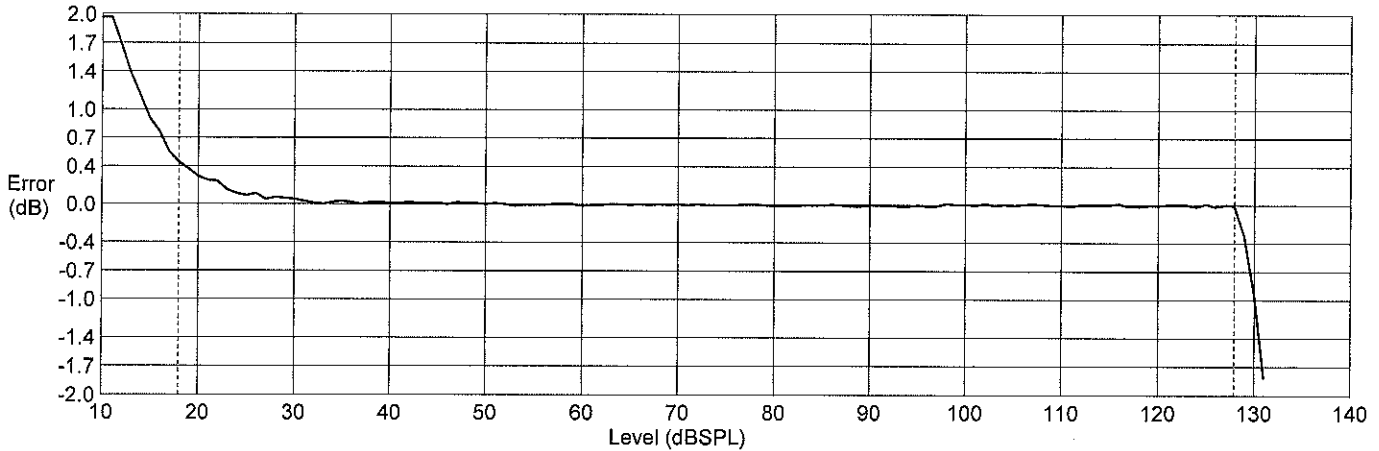
"As received" data is the same as shipped data.
Tested with PRM902 S/N 0836

Signed: 

Technician: Sean Childs

Sound Level Meter Model: 824 Serial Number: A0450
Log Linearity, Differential Linearity and Range Data

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dB SPL. The instrument's Log Linearity A-weighted fast response was then electrically tested using a 1kHz sine wave from 11.0 dB SPL to 131.0 dB SPL in 1.0 dB increments.



Levl dB SPL	Meas dB SPL	Uncert +/- dB	Err dB	Levl dB SPL	Meas dB SPL	Uncert +/- dB	Err dB	Levl dB SPL	Meas dB SPL	Uncert +/- dB	Err dB	Levl dB SPL	Meas dB SPL	Uncert +/- dB	Err dB
11.0	13.0	0.27	2.0	42.0	42.0	0.11	0.0	73.0	73.0	0.11	0.0	104.0	104.0	0.11	0.0
12.0	13.7	0.27	1.7	43.0	43.0	0.11	0.0	74.0	74.0	0.11	0.0	105.0	105.0	0.11	0.0
13.0	14.4	0.27	1.4	44.0	44.0	0.11	0.0	75.0	75.0	0.11	0.0	106.0	106.0	0.11	0.0
14.0	15.1	0.27	1.1	45.0	45.0	0.11	0.0	76.0	76.0	0.11	0.0	107.0	107.0	0.11	0.0
15.0	15.9	0.27	0.9	46.0	46.0	0.11	0.0	77.0	77.0	0.13	0.0	108.0	108.0	0.11	0.0
16.0	16.8	0.27	0.8	47.0	47.0	0.11	0.0	78.0	78.0	0.13	0.0	109.0	109.0	0.11	0.0
17.0	17.5	0.27	0.6	48.0	48.0	0.11	0.0	79.0	79.0	0.12	0.0	110.0	110.0	0.11	0.0
18.0	18.4	0.26	0.4	49.0	49.0	0.11	0.0	80.0	80.0	0.12	0.0	111.0	111.0	0.11	0.0
19.0	19.4	0.26	0.4	50.0	50.0	0.11	0.0	81.0	81.0	0.12	0.0	112.0	112.0	0.11	0.0
20.0	20.3	0.26	0.3	51.0	51.0	0.11	0.0	82.0	82.0	0.12	0.0	113.0	113.0	0.11	0.0
21.0	21.3	0.26	0.3	52.0	52.0	0.11	0.0	83.0	83.0	0.12	0.0	114.0	114.0	0.11	0.0
22.0	22.2	0.26	0.2	53.0	53.0	0.11	0.0	84.0	84.0	0.12	0.0	115.0	115.0	0.11	0.0
23.0	23.1	0.26	0.2	54.0	54.0	0.11	0.0	85.0	85.0	0.11	0.0	116.0	116.0	0.11	0.0
24.0	24.1	0.16	0.1	55.0	55.0	0.11	0.0	86.0	86.0	0.11	0.0	117.0	117.0	0.11	0.0
25.0	25.1	0.16	0.0	56.0	56.0	0.11	0.0	87.0	87.0	0.11	0.0	118.0	118.0	0.11	0.0
26.0	26.1	0.16	0.1	57.0	57.0	0.11	0.0	88.0	88.0	0.11	0.0	119.0	119.0	0.11	0.0
27.0	27.0	0.16	0.0	58.0	58.0	0.11	0.0	89.0	89.0	0.11	0.0	120.0	120.0	0.11	0.0
28.0	28.1	0.16	0.0	59.0	59.0	0.11	0.0	90.0	90.0	0.11	0.0	121.0	121.0	0.11	0.0
29.0	29.1	0.16	0.0	60.0	60.0	0.11	0.0	91.0	91.0	0.11	0.0	122.0	122.0	0.11	0.0
30.0	30.1	0.16	0.0	61.0	61.0	0.11	0.0	92.0	92.0	0.11	0.0	123.0	123.0	0.11	0.0
31.0	31.0	0.16	0.0	62.0	62.0	0.11	0.0	93.0	93.0	0.11	0.0	124.0	124.0	0.11	0.0
32.0	32.0	0.16	0.0	63.0	63.0	0.11	0.0	94.0	94.0	0.11	0.0	125.0	125.0	0.11	0.0
33.0	33.0	0.16	0.0	64.0	64.0	0.11	0.0	95.0	95.0	0.11	0.0	126.0	126.0	0.11	0.0
34.0	34.0	0.15	0.0	65.0	65.0	0.11	0.0	96.0	96.0	0.11	0.0	127.0	127.0	0.11	0.0
35.0	35.0	0.15	0.0	66.0	66.0	0.11	0.0	97.0	97.0	0.11	0.0	128.0	128.0	0.11	0.0
36.0	36.0	0.15	0.0	67.0	67.0	0.11	0.0	98.0	98.0	0.11	0.0	129.0	128.7	0.11	-0.3
37.0	37.0	0.15	0.0	68.0	68.0	0.11	0.0	99.0	99.0	0.11	0.0	130.0	129.1	0.11	-0.9
38.0	38.0	0.15	0.0	69.0	69.0	0.11	0.0	100.0	100.0	0.11	0.0	131.0	129.2	0.11	-1.8
39.0	39.0	0.15	0.0	70.0	70.0	0.11	0.0	101.0	101.0	0.11	0.0				
40.0	40.0	0.11	0.0	71.0	71.0	0.11	0.0	102.0	102.0	0.11	0.0				
41.0	41.0	0.11	0.0	72.0	72.0	0.11	0.0	103.0	103.0	0.11	0.0				

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

Plotted per typical sensitivity of a 2541 microphone; 44.5 mV/Pa & 17.1 pF.

Overload occurs at 128.1 dB SPL.

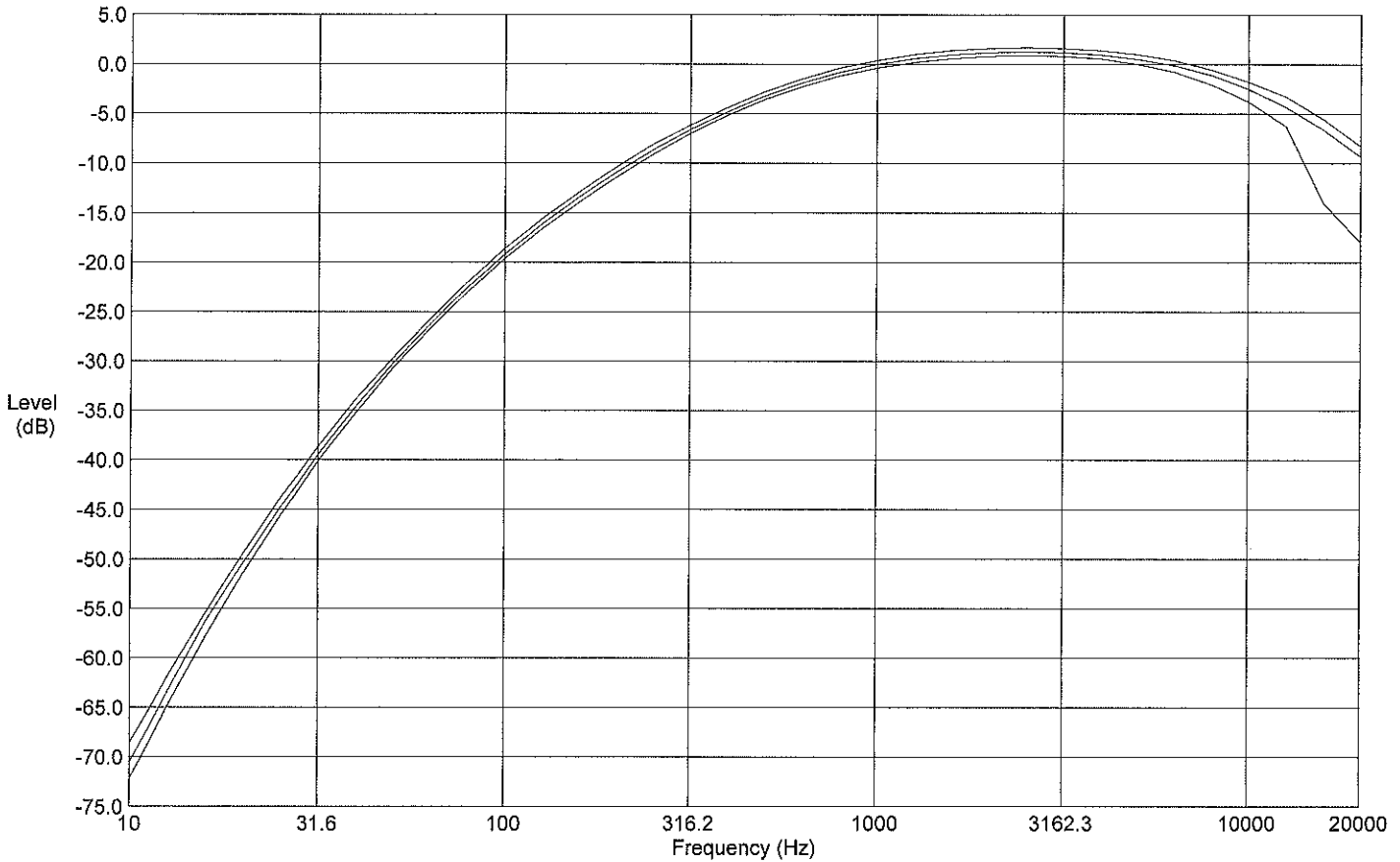
Primary indicator range: 110.0 dB (lower limit: 18.0 dB SPL to upper limit: 128.0 dB SPL).

Dynamic range: 118.8 dB (noise floor: 9.2 dB SPL to upper limit: 128.0 dB SPL).

This instrument is in compliance with IEC 60651 (2001-10) 7.9 and 7.10, ANSI S1.4-1983 3.2, IEC 61672-1 (2002-05) 5.5 class 1 and IEC 60804 (2001-10) 9.2.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Sound Level Meter Model: 824 Serial Number: A0450
Certificate of A-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dB SPL. The instrument's A-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



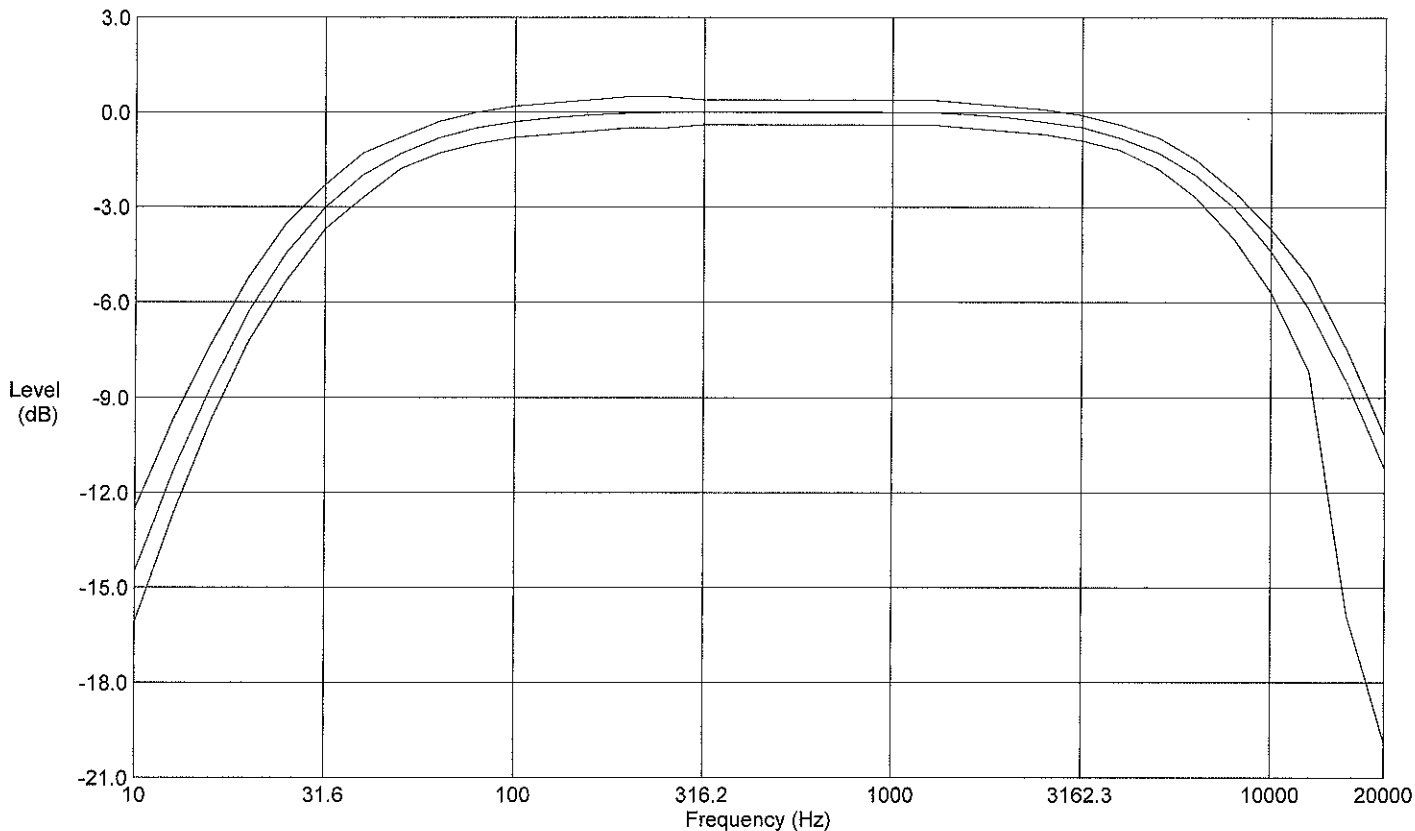
Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance	Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-70.4	-70.58	0.10	-0.18	+1.8, -1.8	501.19	-3.2	-3.24	0.10	-0.04	+0.4, -0.4
12.59	-63.4	-63.46	0.10	-0.06	+1.5, -1.5	630.96	-1.9	-1.93	0.10	-0.03	+0.4, -0.4
15.85	-56.7	-56.42	0.10	0.28	+1.2, -1.2	794.33	-0.8	-0.85	0.10	-0.05	+0.4, -0.4
19.95	-50.5	-50.49	0.10	0.01	+1.0, -1.0	1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
25.12	-44.7	-44.78	0.10	-0.08	+0.9, -0.9	1258.90	0.6	0.58	0.10	-0.02	+0.4, -0.4
31.62	-39.4	-39.50	0.10	-0.10	+0.7, -0.7	1584.90	1.0	0.95	0.10	-0.05	+0.4, -0.4
39.81	-34.6	-34.67	0.10	-0.07	+0.7, -0.7	1995.30	1.2	1.18	0.10	-0.02	+0.4, -0.4
50.12	-30.2	-30.28	0.10	-0.08	+0.5, -0.5	2511.90	1.3	1.25	0.10	-0.05	+0.4, -0.4
63.10	-26.2	-26.24	0.10	-0.04	+0.5, -0.5	3162.30	1.2	1.18	0.10	-0.02	+0.4, -0.4
79.43	-22.5	-22.55	0.10	-0.05	+0.5, -0.5	3981.10	1.0	0.95	0.10	-0.05	+0.4, -0.4
100.00	-19.1	-19.19	0.10	-0.09	+0.5, -0.5	5011.90	0.5	0.53	0.10	0.03	+0.5, -0.5
125.89	-16.1	-16.13	0.10	-0.03	+0.5, -0.5	6309.60	-0.1	-0.13	0.10	-0.03	+0.5, -0.7
158.49	-13.4	-13.40	0.10	0.00	+0.5, -0.5	7943.30	-1.1	-1.13	0.10	-0.03	+0.5, -1.0
199.53	-10.9	-10.92	0.10	-0.02	+0.5, -0.5	10000.00	-2.5	-2.51	0.12	-0.01	+0.7, -1.3
251.19	-8.6	-8.67	0.10	-0.07	+0.5, -0.5	12589.00	-4.3	-4.35	0.12	-0.05	+1.0, -2.0
316.23	-6.6	-6.64	0.10	-0.04	+0.4, -0.4	15849.00	-6.6	-6.63	0.12	-0.03	+1.0, -7.4
398.11	-4.8	-4.85	0.10	-0.05	+0.4, -0.4	19953.00	-9.3	-9.35	0.12	-0.05	+1.0, -8.7

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Sound Level Meter Model: 824 Serial Number: A0450
Certificate of C-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dB SPL. The instrument's C-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



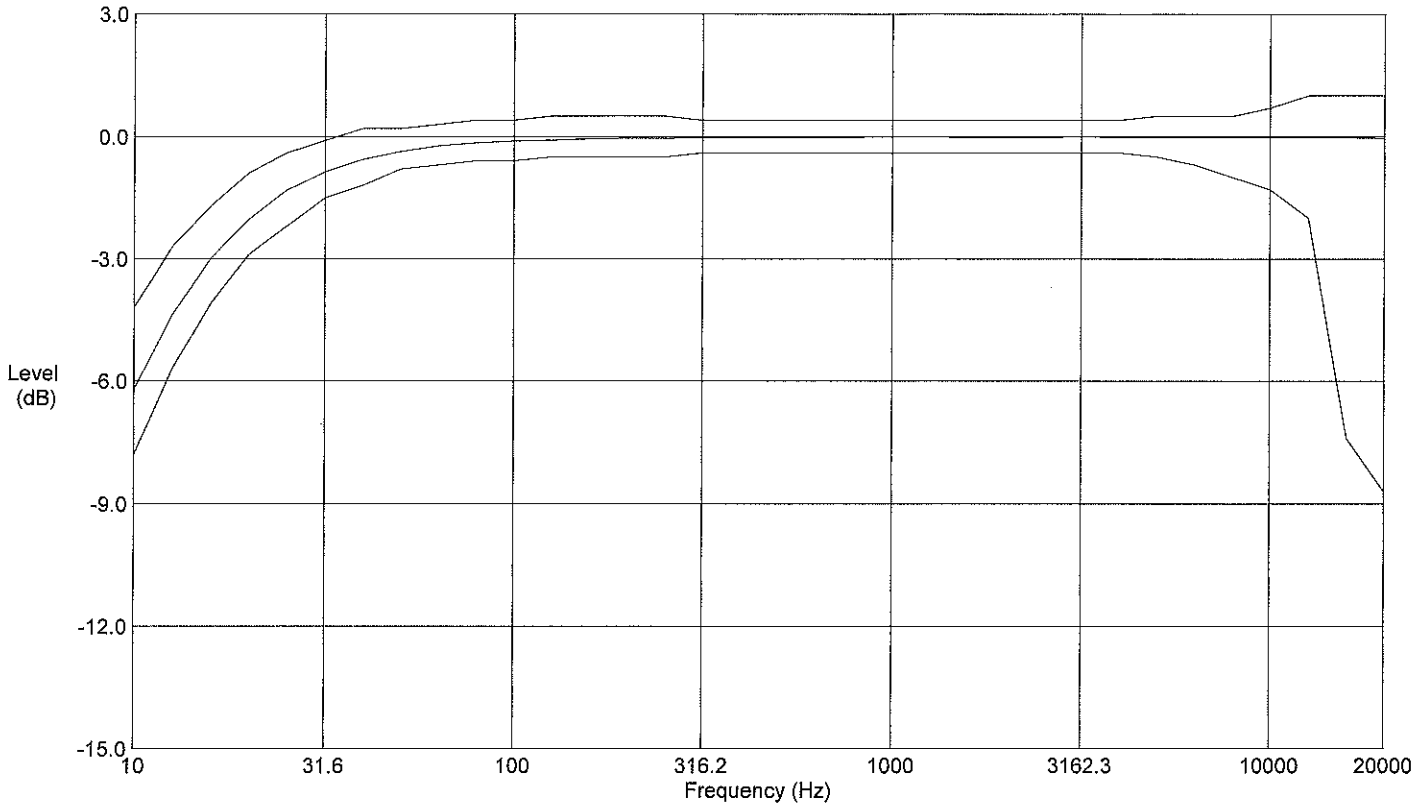
Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance	Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-14.3	-14.49	0.10	-0.19	+1.8, -1.8	501.19	0.0	0.04	0.10	0.04	+0.4, -0.4
12.59	-11.2	-11.34	0.10	-0.14	+1.5, -1.5	630.96	0.0	0.03	0.10	0.03	+0.4, -0.4
15.85	-8.5	-8.64	0.10	-0.14	+1.2, -1.2	794.33	0.0	0.03	0.10	0.03	+0.4, -0.4
19.95	-6.2	-6.29	0.10	-0.09	+1.0, -1.0	1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
25.12	-4.4	-4.43	0.10	-0.03	+0.9, -0.9	1258.90	0.0	-0.02	0.10	-0.02	+0.4, -0.4
31.62	-3.0	-3.03	0.10	-0.03	+0.7, -0.7	1584.90	-0.1	-0.07	0.10	0.03	+0.4, -0.4
39.81	-2.0	-2.00	0.10	0.00	+0.7, -0.7	1995.30	-0.2	-0.16	0.10	0.04	+0.4, -0.4
50.12	-1.3	-1.32	0.10	-0.02	+0.5, -0.5	2511.90	-0.3	-0.31	0.10	-0.01	+0.4, -0.4
63.10	-0.8	-0.82	0.10	-0.02	+0.5, -0.5	3162.30	-0.5	-0.48	0.10	0.02	+0.4, -0.4
79.43	-0.5	-0.50	0.10	0.00	+0.5, -0.5	3981.10	-0.8	-0.82	0.10	-0.02	+0.4, -0.4
100.00	-0.3	-0.31	0.10	-0.01	+0.5, -0.5	5011.90	-1.3	-1.28	0.10	0.02	+0.5, -0.5
125.89	-0.2	-0.18	0.10	0.02	+0.5, -0.5	6309.60	-2.0	-2.00	0.10	0.00	+0.5, -0.7
158.49	-0.1	-0.09	0.10	0.00	+0.5, -0.5	7943.30	-3.0	-3.01	0.10	-0.01	+0.5, -1.0
199.53	0.0	-0.04	0.10	-0.04	+0.5, -0.5	10000.00	-4.4	-4.39	0.12	0.01	+0.7, -1.3
251.19	0.0	0.00	0.10	0.00	+0.5, -0.5	12589.00	-6.2	-6.23	0.12	-0.03	+1.0, -2.0
316.23	0.0	0.03	0.10	0.03	+0.4, -0.4	15849.00	-8.5	-8.52	0.12	-0.02	+1.0, -7.4
398.11	0.0	0.03	0.10	0.03	+0.4, -0.4	19953.00	-11.2	-11.25	0.12	-0.05	+1.0, -8.7

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Sound Level Meter Model: 824 Serial Number: A0450
Certificate of Flat-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dB SPL. The instrument's Flat-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance	Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-6.0	-6.22	0.10	-0.22	+1.8, -1.8	501.19	0.0	-0.03	0.10	-0.03	+0.4, -0.4
12.59	-4.2	-4.39	0.10	-0.19	+1.5, -1.5	630.96	0.0	-0.03	0.10	-0.03	+0.4, -0.4
15.85	-2.9	-2.99	0.10	-0.09	+1.2, -1.2	794.33	0.0	-0.02	0.10	-0.02	+0.4, -0.4
19.95	-1.9	-2.04	0.10	-0.14	+1.0, -1.0	1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
25.12	-1.3	-1.32	0.10	-0.02	+0.9, -0.9	1258.90	0.0	0.00	0.10	0.00	+0.4, -0.4
31.62	-0.8	-0.87	0.10	-0.07	+0.7, -0.7	1584.90	0.0	-0.03	0.10	-0.03	+0.4, -0.4
39.81	-0.5	-0.57	0.10	-0.07	+0.7, -0.7	1995.30	0.0	-0.03	0.10	-0.03	+0.4, -0.4
50.12	-0.3	-0.37	0.10	-0.07	+0.5, -0.5	2511.90	0.0	-0.03	0.10	-0.03	+0.4, -0.4
63.10	-0.2	-0.23	0.10	-0.03	+0.5, -0.5	3162.30	0.0	0.00	0.10	0.00	+0.4, -0.4
79.43	-0.1	-0.16	0.10	-0.06	+0.5, -0.5	3981.10	0.0	-0.03	0.10	-0.03	+0.4, -0.4
100.00	-0.1	-0.11	0.10	-0.01	+0.5, -0.5	5011.90	0.0	-0.03	0.10	-0.03	+0.5, -0.5
125.89	0.0	-0.09	0.10	-0.09	+0.5, -0.5	6309.60	0.0	-0.03	0.10	-0.03	+0.5, -0.7
158.49	0.0	-0.06	0.10	-0.06	+0.5, -0.5	7943.30	0.0	-0.03	0.10	-0.03	+0.5, -1.0
199.53	0.0	-0.04	0.10	-0.04	+0.5, -0.5	10000.00	0.0	-0.03	0.12	-0.03	+0.7, -1.3
251.19	0.0	-0.04	0.10	-0.04	+0.5, -0.5	12589.00	0.0	-0.03	0.12	-0.03	+1.0, -2.0
316.23	0.0	-0.03	0.10	-0.03	+0.4, -0.4	15849.00	0.0	-0.03	0.12	-0.03	+1.0, -7.4
398.11	0.0	-0.03	0.10	-0.03	+0.4, -0.4	19953.00	0.0	-0.04	0.12	-0.04	+1.0, -8.7

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Sound Level Meter Model: 824 Serial Number: A0450
Summary Test Data

dB Offset (added to dBuV readings for dBSPL): 1.0
NoiseFloor: 8.2 (9.2 SPL)
LogLin Reference: 113.0 (114.0 SPL)
Weighted Peak Reference: 116.0 (117.0 SPL)
Overload: 127.1 (128.1 SPL)
LowerRange (max (noisefloor, w/in limits, w/in diff linearity)): 17.0 (18.0 SPL)
UpperRange (min (overload, w/in limits, w/in diff linearity)): 127.0 (128.0 SPL)
UpperLimit (Overload - 0.1): 127.0 (128.0 SPL)
Primary indicator range: 110.0 dB (Minimum Allowed: 105.0)
Dynamic range: 118.8 dB (Minimum Allowed: 110.0)
Gain stages measured at input level 70.00 dBuV:
Gain + 0 reference: 70.01
Gain + 10, Value: 69.98, Error: -0.03, Passed
Gain + 20, Value: 70.01, Error: 0.00, Passed
Gain + 30, Value: 70.01, Error: 0.00, Passed
Gain + 40, Value: 70.03, Error: 0.02, Passed
Gain + 50, Value: 69.98, Error: -0.03, Passed

LogLin Test Run Date: Tue Oct 29 12:16:46 2013. Passed
A Weight Test Run Date: Tue Oct 29 12:30:27 2013. Passed
C Weight Test Run Date: Tue Oct 29 12:32:42 2013. Passed
F Weight Test Run Date: Tue Oct 29 12:34:41 2013. Passed
Crest Test Run Date: Tue Oct 29 13:14:38 2013. Passed
Burst Test Run Date: Tue Oct 29 13:19:56 2013. Passed
Detector Test Run Date: Tue Oct 29 13:23:42 2013. Passed
Frequency Counter Test Run Date: Tue Oct 29 13:28:45 2013. Passed

This 824 has the following purchased options:
Logging SLM - Real-Time Spectrum Analyzer -

Certificate of Calibration and Conformance

Certificate Number 2013-181477

Instrument Model PRM902, Serial Number 0836, was calibrated on 29OCT2013. The instrument meets factory specifications per Procedure D0001.8126.

Instrument found to be in calibration as received: YES

Date Calibrated: 29OCT2013

Calibration due: 29OCT2014

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0617 / 0104	12 Months	16JAN2014	2013-168816
Hewlett Packard	34401A	US36033460	12 Months	01JUL2014	6141807

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 23 ° Centigrade

Relative Humidity: 30 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

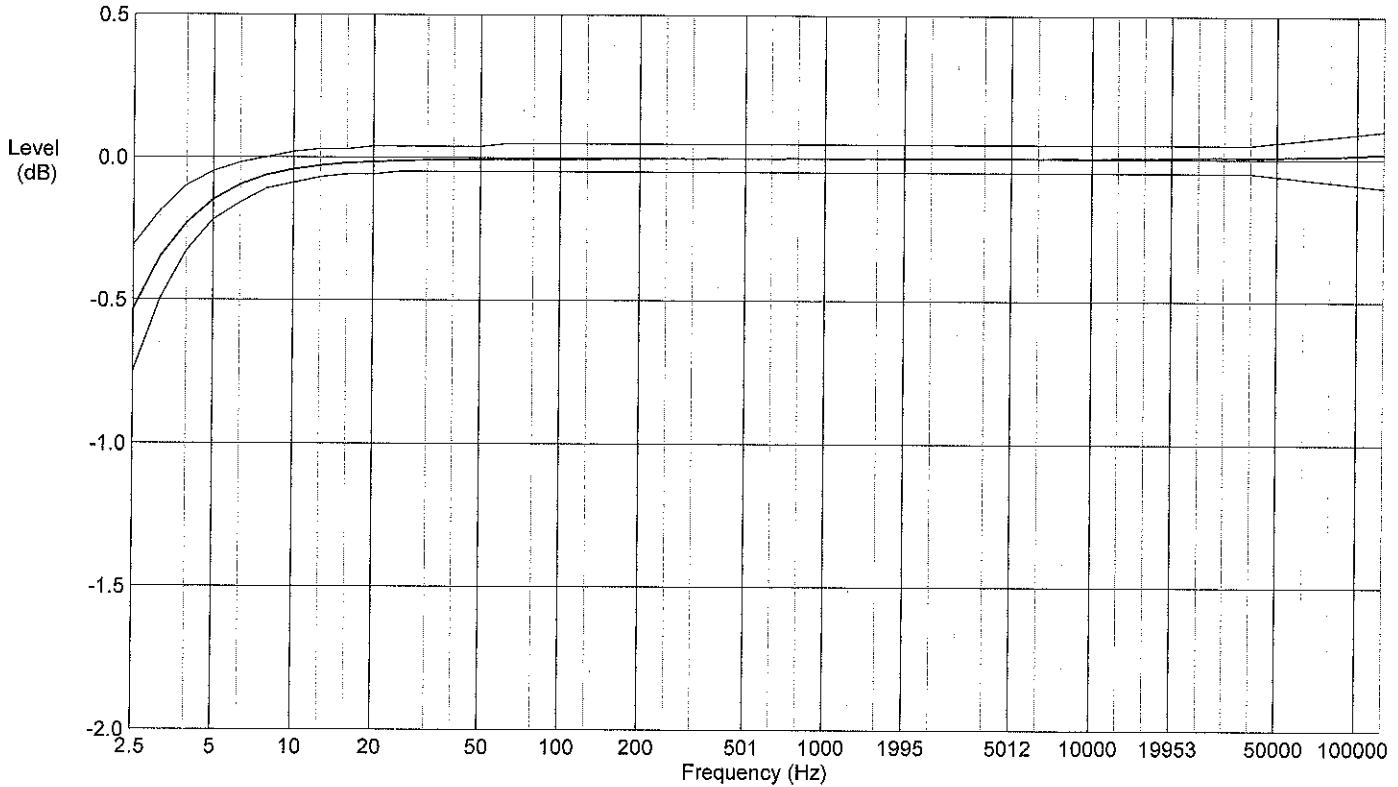
The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"As received" data is the same as shipped data.

Signed: 
Technician: Sean Childs

Preamplifier Model: 902 Serial Number: 0836
Certificate of Electrical Conformance

Frequency response of this model 902 preamplifier was tested at a level of 1 Vrms with 18pF microphone capacitance and driving a short cable. Output level at 1kHz is 0.9809 Vrms (-0.167 dBV), uncertainty 0.033 dB. Results are displayed relative to the level at 1kHz.



Freq (Hz)	Measured (dB)	Uncert (dB)	Tolerance (dB)	Freq (Hz)	Measured (dB)	Uncert (dB)	Tolerance (dB)
2.51	-0.53	0.075	-0.31, -0.75	630.96	-0.00	0.016	+0.05, -0.05
3.16	-0.35	0.058	-0.19, -0.50	794.33	0.00	0.016	+0.05, -0.05
3.98	-0.23	0.058	-0.10, -0.33	1000.00	0.00	0.016	+0.05, -0.05
5.01	-0.15	0.036	-0.05, -0.22	1258.90	0.00	0.016	+0.05, -0.05
6.31	-0.10	0.036	-0.02, -0.16	1584.90	0.00	0.016	+0.05, -0.05
7.94	-0.06	0.036	+0.00, -0.11	1995.30	0.00	0.016	+0.05, -0.05
10.00	-0.04	0.016	+0.02, -0.09	2511.90	0.00	0.016	+0.05, -0.05
12.59	-0.03	0.016	+0.03, -0.07	3162.30	0.00	0.016	+0.05, -0.05
15.85	-0.02	0.016	+0.03, -0.06	3981.10	0.00	0.016	+0.05, -0.05
19.95	-0.02	0.016	+0.04, -0.06	5011.90	0.00	0.016	+0.05, -0.05
25.12	-0.01	0.016	+0.04, -0.05	6309.60	0.00	0.016	+0.05, -0.05
31.62	-0.01	0.016	+0.04, -0.05	7943.30	0.00	0.016	+0.05, -0.05
39.81	-0.01	0.016	+0.04, -0.05	10000.00	0.00	0.016	+0.05, -0.05
50.12	-0.01	0.016	+0.04, -0.05	12589.00	0.00	0.016	+0.05, -0.05
63.10	-0.01	0.016	+0.05, -0.05	15849.00	0.00	0.016	+0.05, -0.05
79.43	-0.01	0.016	+0.05, -0.05	19953.00	0.01	0.016	+0.05, -0.05
100.00	-0.01	0.016	+0.05, -0.05	25250.00	0.01	0.022	+0.05, -0.05
125.89	-0.00	0.016	+0.05, -0.05	31500.00	0.01	0.022	+0.05, -0.05
158.49	-0.00	0.016	+0.05, -0.05	39750.00	0.01	0.022	+0.05, -0.05
199.53	-0.00	0.016	+0.05, -0.05	50000.00	0.01	0.022	+0.06, -0.06
251.19	-0.00	0.016	+0.05, -0.05	63000.00	0.01	0.047	+0.07, -0.07
316.23	-0.00	0.016	+0.05, -0.05	79500.00	0.01	0.047	+0.08, -0.08
398.11	-0.00	0.016	+0.05, -0.05	100000.00	0.02	0.047	+0.09, -0.09
501.19	-0.00	0.016	+0.05, -0.05	126000.00	0.02	0.063	+0.10, -0.10

Noise floor data: 1kHz (1/3 Octave) = 0.36 uV, -8.8 dBuV, uncertainty = 0.47 dB
 Flat (20Hz-20kHz) = 3.5 uV, 10.8 dBuV, uncertainty = 0.47 dB
 Awt = 1.9 uV, 5.5 dBuV, uncertainty = 0.46 dB

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

Technician: Sean Childs Test Date: 29OCT2013



Sound Level Meter 824 Kit 2

Sound Level Meter	
Make and Model	Larson-Davis Model 824 SLM and RTA
Serial No.	824A1556
Pre-amplifier	
Make and Model	Larson-Davis Model PRM902
Serial No.	2072
Microphone	
Make and Model	Larson-Davis Model 2559 precision air-condenser microphone
Serial No.	3118
Calibrator	
Make and Model	Larson-Davis CAL200 precision acoustic calibrator (1000 Hz)
Serial No.	3029

Certificate of Calibration and Conformance

Certificate Number 2014-187110

Instrument Model CAL200, Serial Number 3029, was calibrated on 28 Feb 2014. The instrument meets factory specifications per Procedure D0001.8190, IEC 60942:2003.

Instrument found to be in calibration as received: YES

Date Calibrated: 28 Feb 2014

Calibration due: 28 Feb 2016

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2900	0661	12 Months	8 Apr 2014	2013-172252
Larson Davis	2559	2506	12 Months	13 Jun 2014	29027
Larson Davis	MTS1000/2201	0111	12 Months	22 Aug 2014	SM082213
Larson Davis	PRM902	0480	12 Months	23 Aug 2014	2013-178669
Hewlett Packard	34401A	3146A10352	12 Months	3 Sep 2014	6214490
PCB	1502C02FJ15PSIA	1429	12 Months	2 Oct 2014	3463562806
Larson Davis	PRM915	0112	12 Months	9 Oct 2014	2013-180644

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Environmental test conditions as shown on calibration report.

Affirmations


This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

Before: 114.05 dB, 94.08 dB, 1000.1 Hz @ sea level.

After: Refer to Certificate of Measured Output.

Signed: 
Technician: Scott Montgomery

Certificate of Calibration and Conformance

Certificate Number 2014-187110

Instrument Model CAL200, Serial Number 3029, was calibrated on 28 Feb 2014. The instrument meets factory specifications per Procedure D0001.8190, IEC 60942:2003.

Instrument found to be in calibration as received: YES

Date Calibrated: 28 Feb 2014

Calibration due: 28 Feb 2015

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2900	0661	12 Months	8 Apr 2014	2013-172252
Larson Davis	2559	2506	12 Months	13 Jun 2014	29027
Larson Davis	MTS1000/2201	0111	12 Months	22 Aug 2014	SM082213
Larson Davis	PRM902	0480	12 Months	23 Aug 2014	2013-178669
Hewlett Packard	34401A	3146A10352	12 Months	3 Sep 2014	6214490
PCB	1502C02FJ15PSIA	1429	12 Months	2 Oct 2014	3463562806
Larson Davis	PRM915	0112	12 Months	9 Oct 2014	2013-180644

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Environmental test conditions as shown on calibration report.

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

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Before: 114.05 dB, 94.08 dB, 1000.1 Hz @ sea level.

After: Refer to Certificate of Measured Output.

Signed: 
Technician: Scott Montgomery

Performance at Reference Conditions

Nominal Level (dB SPL):	94	114
Measured Level (dB SPL):	94.00	113.99
Expanded Uncertainty (dB):	0.137	0.135
Level Error Limit (dB):	±0.34	±0.33
Nominal Frequency (Hz):	1000	1000
Measured Frequency (Hz):	1000.1	1000.1
Expanded Uncertainty (Hz):	0.2	0.2
Frequency Error Limit (Hz):	±10.0	±10.0
Measured Distortion (%):	0.35	0.34
Expanded Uncertainty (%):	0.25	0.25
Distortion Limit (%):	2.0	2.0

The data is acquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity.

Environmental Conditions

Temperature (°C):	23	23
Relative Humidity (%):	37	35
Static Pressure (kPa):	101.2	101.2

Reference Microphone

Model: Larson Davis 2559
Serial Number: 2506
Open Circuit Sensitivity: 12.230 mV/Pascal
Uncertainty: 0.110 dB

Influence of Static Pressure

Nominal Level (dB SPL):		114		
Nominal Pressure (kPa)	Pressure (kPa)	Level Change (dB)	Frequency Change (Hz)	Distortion (%)
108.0	108.1	-0.04	0.00	0.35
101.3	101.4	0.00	0.00	0.34
92.0	91.9	0.04	0.00	0.34
83.0	82.9	0.05	-0.00	0.33
74.0	74.1	0.01	-0.00	0.34
65.0	65.0	-0.10	-0.00	0.34
Expanded Uncertainty:	1.0	0.04	0.20	0.25
Limit:		±0.30	±10.0	2.0

Reference microphone corrections applied.

Environmental Conditions

Temperature (°C):	24
Relative Humidity (%):	35

Reference Microphone

Model: Larson Davis 2559
Serial Number: 2506

Static pressure was measured with a calibrated Motorola pressure sensor MPX2100AP.
Temperature and humidity was measured with a calibrated Fluke 1620A sensor.
Expanded uncertainty of environmental measurements: 0.3 °C, 3 %RH, 1.0 kPa
Uncertainty values are given at 95% confidence level (k = 2).

A Sound Level Meter can be calibrated to a level (L) defined as: L = measured level + pressure sensitivity
or if a Sound Level Meter is calibrated using the nominal level, the adjustments to data (X) are defined as:
X = measured level - nominal level - pressure sensitivity

Certificate of Calibration and Conformance

Certificate Number 2014-187040

Microphone Model 2559, Serial Number 3118, was calibrated on 26 Feb 2014. The microphone meets factory specifications per Test Procedure D0001.8167.

Instrument found to be in calibration as received: YES

Date Calibrated: 26 Feb 2014

Calibration due: 26 Feb 2016

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2559	2506	12 Months	13 Jun 2014	29027
Larson Davis	2900	0575	12 Months	24 Jul 2014	2013-177110
Larson Davis	2559	3034LF	12 Months	13 Aug 2014	2013-178081
Larson Davis	PRM902	0206	12 Months	15 Aug 2014	2013-178254
Larson Davis	MTS1000 / 2201	1000 / 0100	12 Months	3 Sep 2014	SM090313
Larson Davis	PRM902	0529	12 Months	10 Sep 2014	2013-179249
Larson Davis	PRM902	0528	12 Months	10 Sep 2014	2013-179248
Hewlett Packard	34401A	3146A62099	12 Months	4 Dec 2014	6327913
Larson Davis	PRM915	0102	12 Months	11 Dec 2014	2013-183533
Larson Davis	PRM916	0102	12 Months	11 Dec 2014	2013-183534
Larson Davis	CAL250	42630	12 Months	3 Jan 2015	2014-184458

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"AS RECEIVED" data is the same as shipped data.

Signed: *Abraham Ortega*
Technician: Abraham Ortega

Certificate of Calibration and Conformance

Certificate Number 2014-187040

Microphone Model 2559, Serial Number 3118, was calibrated on 26 Feb 2014. The microphone meets factory specifications per Test Procedure D0001.8167.

Instrument found to be in calibration as received: YES

Date Calibrated: 26 Feb 2014

Calibration due: 26 Feb 2015

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2559	2506	12 Months	13 Jun 2014	29027
Larson Davis	2900	0575	12 Months	24 Jul 2014	2013-177110
Larson Davis	2559	3034LF	12 Months	13 Aug 2014	2013-178081
Larson Davis	PRM902	0206	12 Months	15 Aug 2014	2013-178254
Larson Davis	MTS1000 / 2201	1000 / 0100	12 Months	3 Sep 2014	SM090313
Larson Davis	PRM902	0529	12 Months	10 Sep 2014	2013-179249
Larson Davis	PRM902	0528	12 Months	10 Sep 2014	2013-179248
Hewlett Packard	34401A	3146A62099	12 Months	4 Dec 2014	6327913
Larson Davis	PRM915	0102	12 Months	11 Dec 2014	2013-183533
Larson Davis	PRM916	0102	12 Months	11 Dec 2014	2013-183534
Larson Davis	CAL250	42630	12 Months	3 Jan 2015	2014-184458

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"AS RECEIVED" data is the same as shipped data.

Signed: 
Technician: Abraham Ortega



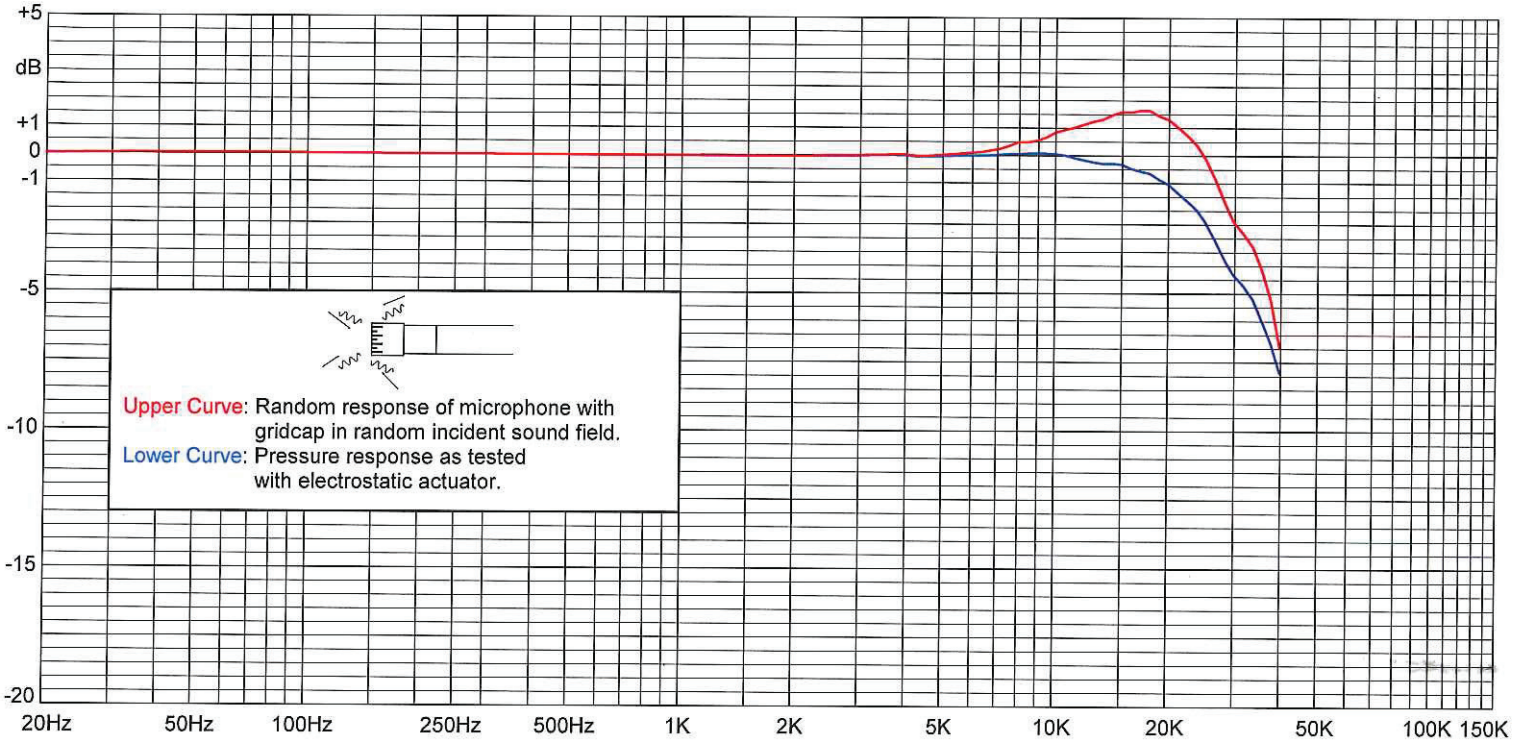
Larson Davis

Larson-Davis 1/2" Microphone Calibration Chart

Model: 2559 Serial Number: 3118

Open Circuit Sensitivity @ 1014.1 mbar & 251.19 Hz
 -38.76 dB re 1V/Pascal
 11.54 mV/Pascal
 +12.74 K_o (-dB re 50 mV/Pascal)
Expanded Uncertainty @ ~95% confidence level
 0.18 dB

Capacitance @ 251.2 Hz
 19.1 pF
Lower Limiting Frequency
 -3 dB @ 2.48 Hz
Test Conditions:
 Polarization Voltage 200 V
 Ambient Pressure 1014.1 mbar
 Temperature 24.4 °C
 Relative Humidity 29.7 %



Upper Curve: Random response of microphone with gridcap in random incident sound field.
Lower Curve: Pressure response as tested with electrostatic actuator.

Frequency Response (0 dB @ 251.19 Hz)
Random and actuator response with reference to level at 251.19 Hz

Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)
19.95	-0.01	-0.01	1000.00	-0.03	-0.03	2660.73	-0.01	-0.02	7079.46	0.25	0.03	18836.49	1.45	-0.87
25.12	0.01	0.01	1059.25	-0.03	-0.03	2818.38	-0.01	-0.02	7498.94	0.35	0.05	19952.62	1.32	-1.03
31.62	0.03	0.03	1122.02	-0.03	-0.03	2985.38	-0.01	-0.01	7943.28	0.49	0.06	21250.00	1.01	-1.38
39.81	0.03	0.03	1188.50	-0.03	-0.03	3162.28	0.02	-0.00	8413.95	0.49	0.08	22500.00	0.71	-1.66
50.12	0.03	0.03	1258.93	-0.03	-0.03	3349.65	0.01	-0.00	8912.51	0.55	0.09	23750.00	0.36	-1.98
63.10	0.03	0.03	1333.52	-0.03	-0.03	3548.13	0.02	0.01	9440.61	0.67	0.08	25000.00	-0.11	-2.41
79.43	0.02	0.02	1412.54	-0.03	-0.03	3758.37	0.04	0.02	10000.00	0.85	0.05	26500.00	-0.83	-3.05
100.00	0.02	0.02	1496.24	-0.03	-0.03	3981.07	0.02	-0.00	10592.54	0.95	0.01	28250.00	-1.75	-3.82
125.89	0.01	0.01	1584.89	-0.03	-0.03	4216.97	-0.02	-0.04	11220.19	1.02	-0.09	29750.00	-2.39	-4.32
158.49	0.01	0.01	1678.80	-0.03	-0.03	4466.84	-0.02	-0.04	11885.02	1.14	-0.16	31500.00	-2.80	-4.68
199.53	0.00	0.00	1778.28	-0.03	-0.03	4731.51	0.00	-0.03	12589.25	1.25	-0.23	33500.00	-3.30	-5.20
251.19	0.00	0.00	1883.65	-0.03	-0.03	5011.87	0.02	-0.02	13335.21	1.33	-0.29	35500.00	-4.15	-5.99
316.23	0.00	-0.00	1995.26	-0.03	-0.03	5308.84	0.05	-0.01	14125.38	1.48	-0.28	37500.00	-5.20	-6.76
398.11	-0.01	-0.01	2113.49	-0.03	-0.03	5623.41	0.08	0.01	14962.36	1.59	-0.31	39750.00	-6.97	-7.87
501.19	-0.01	-0.01	2238.72	-0.03	-0.03	5956.62	0.10	0.00	15848.93	1.58	-0.47			
630.96	-0.02	-0.02	2371.37	-0.01	-0.02	6309.57	0.13	0.00	16788.04	1.65	-0.55			
794.33	-0.02	-0.02	2511.89	0.00	-0.01	6683.44	0.18	0.01	17782.80	1.64	-0.63			

Certificate of Calibration and Conformance

Certificate Number 2014-187268

Instrument Model 824, Serial Number A1556, was calibrated on 4 Mar 2014. The instrument meets factory specifications per Procedure D0001.8046, IEC 61672-1:2002 Class 1; IEC 60651-2001, 60804-2000 and ANSI S1.4-1983 Type 1 1/3, 1/1 Oct. Filters; S1.11-1986 Type 1C; IEC61260-am1-2001 Class 1.

Instrument found to be in calibration as received: YES

Date Calibrated: 4 Mar 2014

Calibration due: 4 Mar 2016

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0662/0114	12 Months	17 Jan 2015	2014-185085

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 23 ° Centigrade

Relative Humidity: 28 %

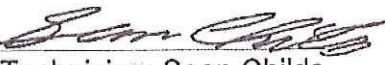
Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"As received" data is the same as shipped data.
Tested with PRM902 S/N 2072

Signed: 
Technician: Sean Childs

Certificate of Calibration and Conformance

Certificate Number 2014-187268

Instrument Model 824, Serial Number A1556, was calibrated on 4 Mar 2014. The instrument meets factory specifications per Procedure D0001.8046, IEC 61672-1:2002 Class 1; IEC 60651-2001, 60804-2000 and ANSI S1.4-1983 Type 1 1/3, 1/1 Oct. Filters; S1.11-1986 Type 1C; IEC61260-am1-2001 Class 1 .

Instrument found to be in calibration as received: YES

Date Calibrated: 4 Mar 2014

Calibration due: 4 Mar 2015

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0662/0114	12 Months	17 Jan 2015	2014-185085

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 23 ° Centigrade

Relative Humidity: 28 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

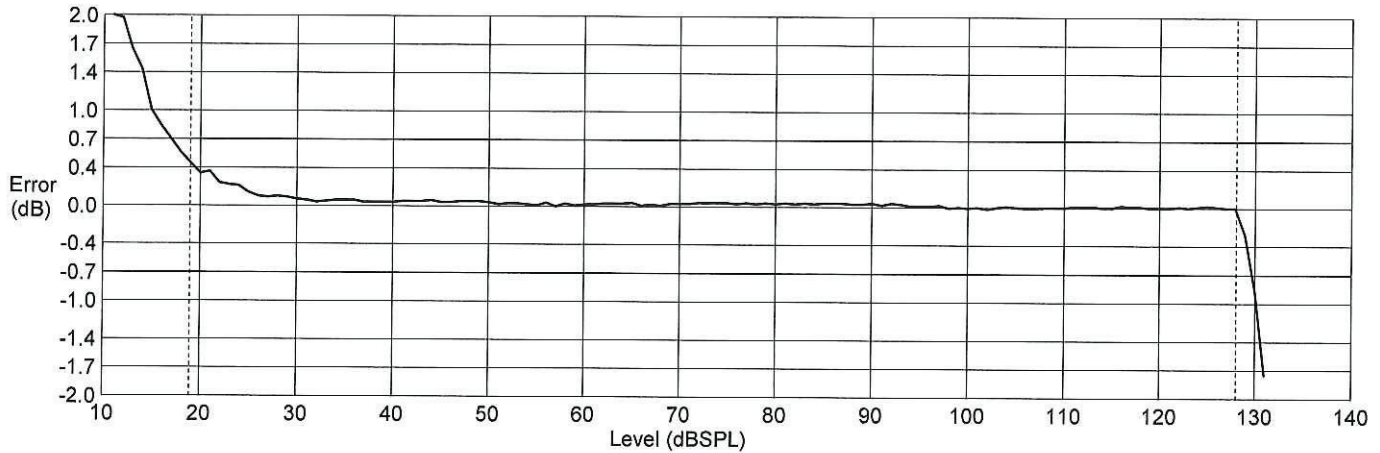
The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"As received" data is the same as shipped data.
Tested with PRM902 S/N 2072

Signed: 
Technician: Sean Childs

Sound Level Meter Model: 824 Serial Number: A1556
Log Linearity, Differential Linearity and Range Data

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dB SPL. The instrument's Log Linearity A-weighted fast response was then electrically tested using a 1kHz sine wave from 11.0 dB SPL to 131.0 dB SPL in 1.0 dB increments.



Levl dB SPL	Meas dB SPL	Uncert +/- dB	Err dB	Levl dB SPL	Meas dB SPL	Uncert +/- dB	Err dB	Levl dB SPL	Meas dB SPL	Uncert +/- dB	Err dB	Levl dB SPL	Meas dB SPL	Uncert +/- dB	Err dB
11.0	13.3	0.27	2.3	42.0	42.0	0.11	0.0	73.0	73.0	0.11	0.0	104.0	104.0	0.11	0.0
12.0	14.0	0.27	2.0	43.0	43.0	0.11	0.0	74.0	74.0	0.11	0.0	105.0	105.0	0.11	0.0
13.0	14.6	0.27	1.6	44.0	44.1	0.11	0.0	75.0	75.0	0.11	0.0	106.0	106.0	0.11	0.0
14.0	15.4	0.27	1.4	45.0	45.0	0.11	0.0	76.0	76.0	0.11	0.0	107.0	107.0	0.11	0.0
15.0	16.0	0.27	1.0	46.0	46.0	0.11	0.0	77.0	77.0	0.13	0.0	108.0	108.0	0.11	0.0
16.0	16.8	0.27	0.8	47.0	47.0	0.11	0.0	78.0	78.0	0.13	0.0	109.0	109.0	0.11	0.0
17.0	17.7	0.27	0.7	48.0	48.0	0.11	0.0	79.0	79.0	0.12	0.0	110.0	110.0	0.11	0.0
18.0	18.6	0.26	0.6	49.0	49.0	0.11	0.0	80.0	80.0	0.12	0.0	111.0	111.0	0.11	0.0
19.0	19.4	0.26	0.4	50.0	50.0	0.11	0.0	81.0	81.0	0.12	0.0	112.0	112.0	0.11	0.0
20.0	20.3	0.26	0.3	51.0	51.0	0.11	0.0	82.0	82.0	0.12	0.0	113.0	113.0	0.11	0.0
21.0	21.4	0.26	0.4	52.0	52.0	0.11	0.0	83.0	83.0	0.12	0.0	114.0	114.0	0.11	0.0
22.0	22.2	0.26	0.2	53.0	53.0	0.11	0.0	84.0	84.0	0.12	0.0	115.0	115.0	0.11	0.0
23.0	23.2	0.26	0.2	54.0	54.0	0.11	0.0	85.0	85.0	0.11	0.0	116.0	116.0	0.11	0.0
24.0	24.2	0.16	0.2	55.0	55.0	0.11	0.0	86.0	86.0	0.11	0.0	117.0	117.0	0.11	0.0
25.0	25.1	0.16	0.1	56.0	56.0	0.11	0.0	87.0	87.0	0.11	0.0	118.0	118.0	0.11	0.0
26.0	26.1	0.16	0.1	57.0	57.0	0.11	0.0	88.0	88.0	0.11	0.0	119.0	119.0	0.11	0.0
27.0	27.1	0.16	0.0	58.0	58.0	0.11	0.0	89.0	89.0	0.11	0.0	120.0	120.0	0.11	0.0
28.0	28.1	0.16	0.1	59.0	59.0	0.11	0.0	90.0	90.0	0.11	0.0	121.0	121.0	0.11	0.0
29.0	29.1	0.16	0.0	60.0	60.0	0.11	0.0	91.0	91.0	0.11	0.0	122.0	122.0	0.11	0.0
30.0	30.1	0.16	0.0	61.0	61.0	0.11	0.0	92.0	92.0	0.11	0.0	123.0	123.0	0.11	0.0
31.0	31.1	0.16	0.0	62.0	62.0	0.11	0.0	93.0	93.0	0.11	0.0	124.0	124.0	0.11	0.0
32.0	32.0	0.16	0.0	63.0	63.0	0.11	0.0	94.0	94.0	0.11	0.0	125.0	125.0	0.11	0.0
33.0	33.0	0.16	0.0	64.0	64.0	0.11	0.0	95.0	95.0	0.11	0.0	126.0	126.0	0.11	0.0
34.0	34.1	0.15	0.0	65.0	65.0	0.11	0.0	96.0	96.0	0.11	0.0	127.0	127.0	0.11	0.0
35.0	35.1	0.15	0.0	66.0	66.0	0.11	0.0	97.0	97.0	0.11	0.0	128.0	128.0	0.11	0.0
36.0	36.1	0.15	0.0	67.0	67.0	0.11	0.0	98.0	98.0	0.11	0.0	129.0	128.7	0.11	-0.3
37.0	37.0	0.15	0.0	68.0	68.0	0.11	0.0	99.0	99.0	0.11	0.0	130.0	129.1	0.11	-0.9
38.0	38.0	0.15	0.0	69.0	69.0	0.11	0.0	100.0	100.0	0.11	0.0	131.0	129.2	0.11	-1.8
39.0	39.0	0.15	0.0	70.0	70.0	0.11	0.0	101.0	101.0	0.11	0.0				
40.0	40.0	0.11	0.0	71.0	71.0	0.11	0.0	102.0	102.0	0.11	0.0				
41.0	41.0	0.11	0.0	72.0	72.0	0.11	0.0	103.0	103.0	0.11	0.0				

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

Plotted per typical sensitivity of a 2541 microphone; 44.5 mV/Pa & 17.1 pF.

Overload occurs at 128.2 dB SPL.

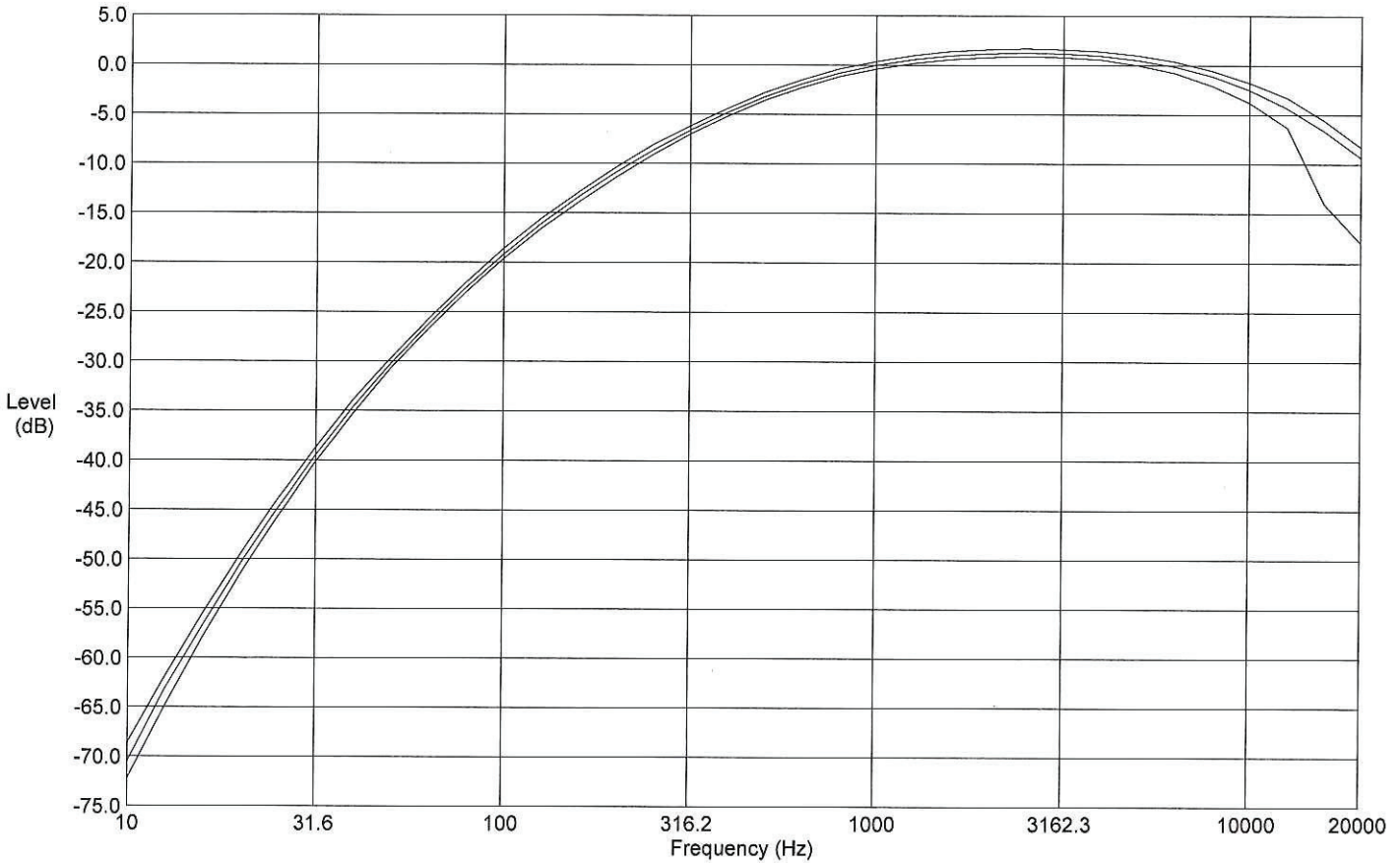
Primary indicator range: 109.1 dB (lower limit: 19.0 dB SPL to upper limit: 128.1 dB SPL).

Dynamic range: 119.3 dB (noise floor: 8.8 dB SPL to upper limit: 128.1 dB SPL).

This instrument is in compliance with IEC 60651 (2001-10) 7.9 and 7.10, ANSI S1.4-1983 3.2, IEC 61672-1 (2002-05) 5.5 class 1 and IEC 60804 (2001-10) 9.2.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Sound Level Meter Model: 824 Serial Number: A1556
Certificate of A-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dB SPL. The instrument's A-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



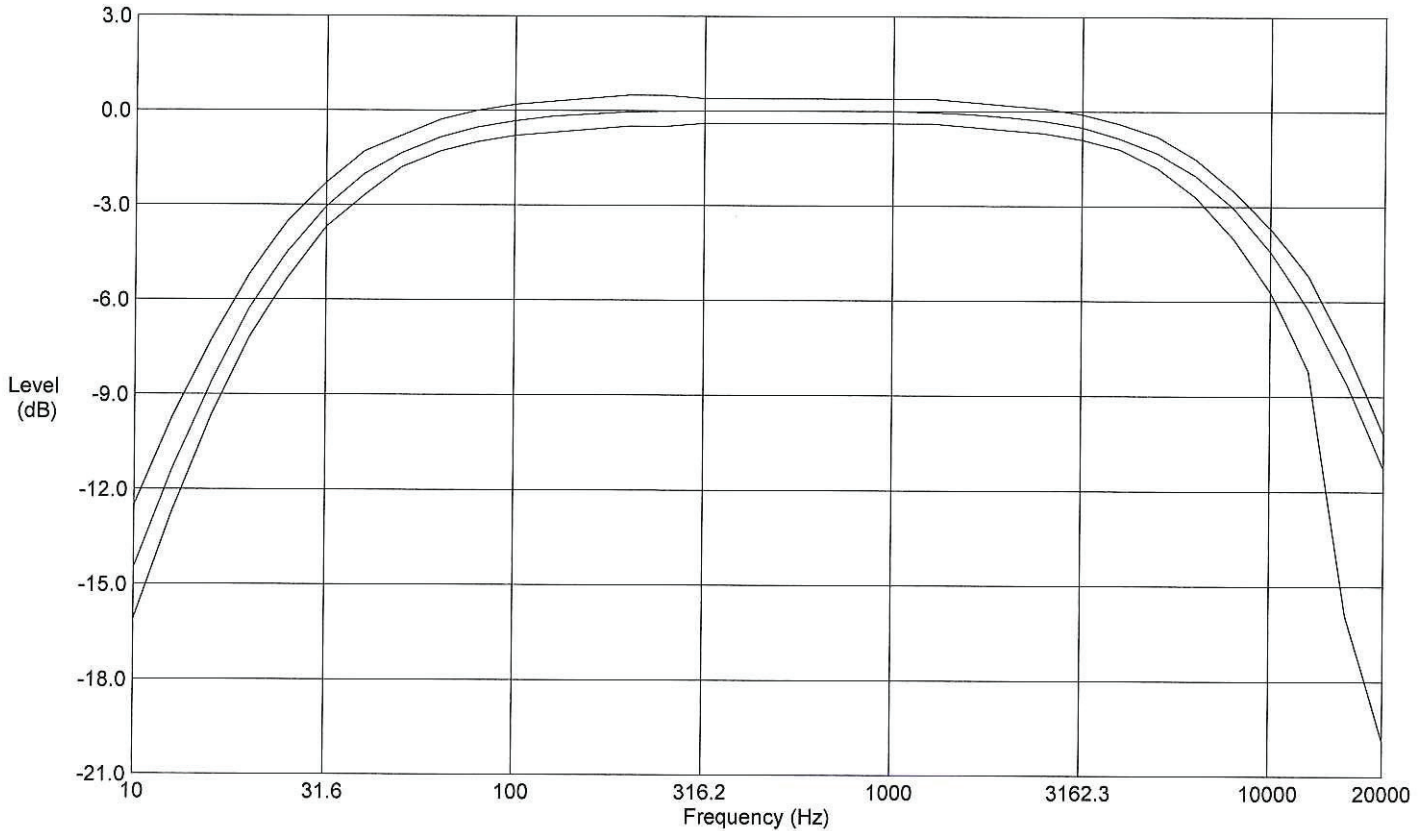
Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance	Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-70.4	-70.52	0.10	-0.12	+1.8, -1.8	501.19	-3.2	-3.25	0.10	-0.05	+0.4, -0.4
12.59	-63.4	-63.17	0.10	0.23	+1.5, -1.5	630.96	-1.9	-1.91	0.10	-0.01	+0.4, -0.4
15.85	-56.7	-56.73	0.10	-0.03	+1.2, -1.2	794.33	-0.8	-0.84	0.10	-0.04	+0.4, -0.4
19.95	-50.5	-50.51	0.10	-0.01	+1.0, -1.0	1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
25.12	-44.7	-44.76	0.10	-0.06	+0.9, -0.9	1258.90	0.6	0.58	0.10	-0.02	+0.4, -0.4
31.62	-39.4	-39.49	0.10	-0.09	+0.7, -0.7	1584.90	1.0	0.95	0.10	-0.05	+0.4, -0.4
39.81	-34.6	-34.67	0.10	-0.07	+0.7, -0.7	1995.30	1.2	1.18	0.10	-0.02	+0.4, -0.4
50.12	-30.2	-30.27	0.10	-0.07	+0.5, -0.5	2511.90	1.3	1.25	0.10	-0.05	+0.4, -0.4
63.10	-26.2	-26.22	0.10	-0.02	+0.5, -0.5	3162.30	1.2	1.18	0.10	-0.02	+0.4, -0.4
79.43	-22.5	-22.53	0.10	-0.03	+0.5, -0.5	3981.10	1.0	0.95	0.10	-0.05	+0.4, -0.4
100.00	-19.1	-19.18	0.10	-0.08	+0.5, -0.5	5011.90	0.5	0.53	0.10	0.03	+0.5, -0.5
125.89	-16.1	-16.13	0.10	-0.03	+0.5, -0.5	6309.60	-0.1	-0.14	0.10	-0.04	+0.5, -0.7
158.49	-13.4	-13.38	0.10	0.02	+0.5, -0.5	7943.30	-1.1	-1.13	0.10	-0.03	+0.5, -1.0
199.53	-10.9	-10.90	0.10	0.00	+0.5, -0.5	10000.00	-2.5	-2.51	0.12	-0.01	+0.7, -1.3
251.19	-8.6	-8.65	0.10	-0.05	+0.5, -0.5	12589.00	-4.3	-4.35	0.12	-0.05	+1.0, -2.0
316.23	-6.6	-6.63	0.10	-0.03	+0.4, -0.4	15849.00	-6.6	-6.63	0.12	-0.03	+1.0, -7.4
398.11	-4.8	-4.82	0.10	-0.02	+0.4, -0.4	19953.00	-9.3	-9.36	0.12	-0.06	+1.0, -8.7

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Sound Level Meter Model: 824 Serial Number: A1556
Certificate of C-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dB SPL. The instrument's C-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



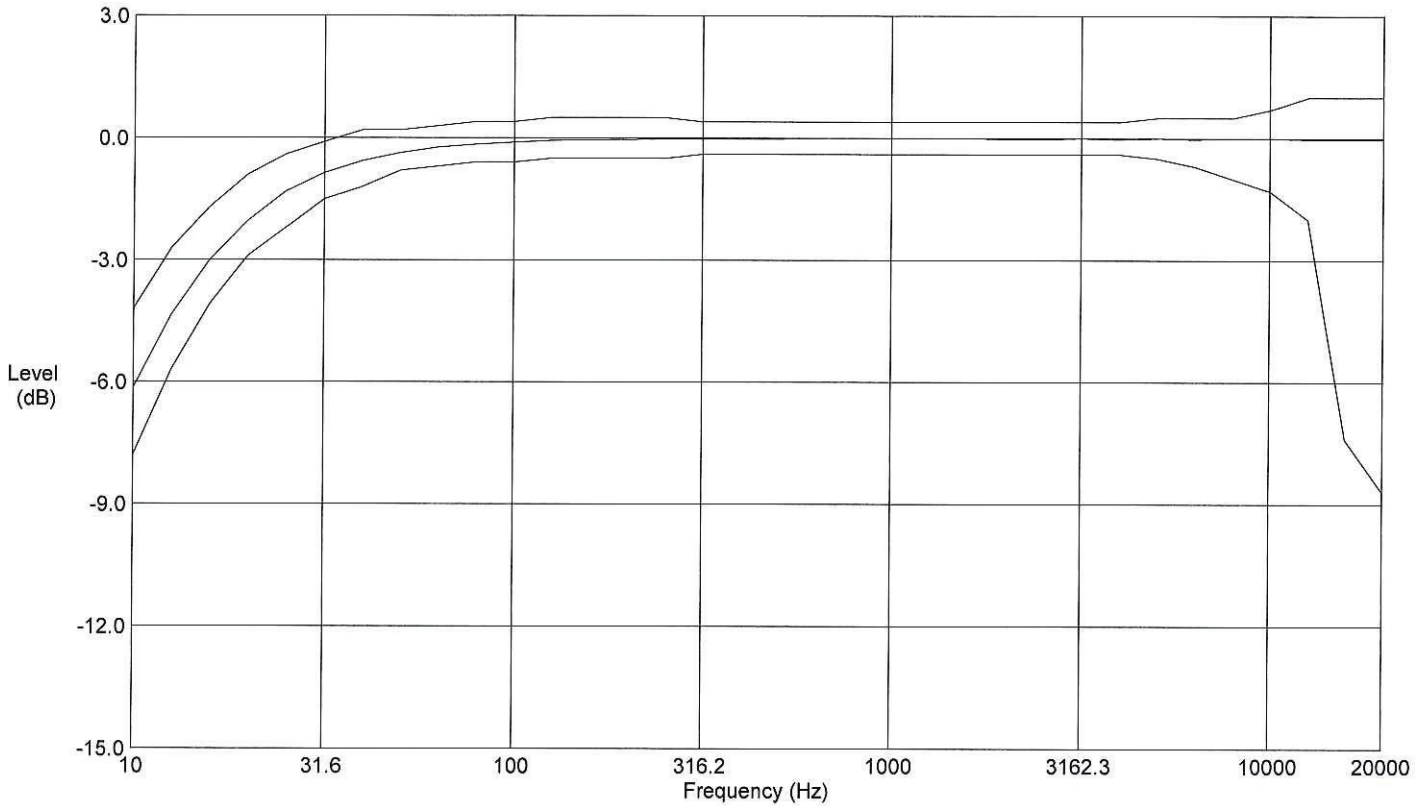
Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance	Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-14.3	-14.48	0.10	-0.18	+1.8, -1.8	501.19	0.0	0.01	0.10	0.00	+0.4, -0.4
12.59	-11.2	-11.35	0.10	-0.15	+1.5, -1.5	630.96	0.0	0.01	0.10	0.00	+0.4, -0.4
15.85	-8.5	-8.65	0.10	-0.15	+1.2, -1.2	794.33	0.0	0.00	0.10	0.00	+0.4, -0.4
19.95	-6.2	-6.29	0.10	-0.09	+1.0, -1.0	1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
25.12	-4.4	-4.47	0.10	-0.07	+0.9, -0.9	1258.90	0.0	-0.05	0.10	-0.05	+0.4, -0.4
31.62	-3.0	-3.07	0.10	-0.07	+0.7, -0.7	1584.90	-0.1	-0.10	0.10	0.00	+0.4, -0.4
39.81	-2.0	-2.03	0.10	-0.03	+0.7, -0.7	1995.30	-0.2	-0.19	0.10	0.00	+0.4, -0.4
50.12	-1.3	-1.35	0.10	-0.05	+0.5, -0.5	2511.90	-0.3	-0.31	0.10	-0.01	+0.4, -0.4
63.10	-0.8	-0.86	0.10	-0.06	+0.5, -0.5	3162.30	-0.5	-0.51	0.10	-0.01	+0.4, -0.4
79.43	-0.5	-0.54	0.10	-0.04	+0.5, -0.5	3981.10	-0.8	-0.86	0.10	-0.06	+0.4, -0.4
100.00	-0.3	-0.34	0.10	-0.04	+0.5, -0.5	5011.90	-1.3	-1.32	0.10	-0.02	+0.5, -0.5
125.89	-0.2	-0.19	0.10	0.00	+0.5, -0.5	6309.60	-2.0	-2.03	0.10	-0.03	+0.5, -0.7
158.49	-0.1	-0.12	0.10	-0.02	+0.5, -0.5	7943.30	-3.0	-3.04	0.10	-0.04	+0.5, -1.0
199.53	0.0	-0.05	0.10	-0.05	+0.5, -0.5	10000.00	-4.4	-4.42	0.12	-0.02	+0.7, -1.3
251.19	0.0	-0.03	0.10	-0.03	+0.5, -0.5	12589.00	-6.2	-6.26	0.12	-0.06	+1.0, -2.0
316.23	0.0	0.00	0.10	0.00	+0.4, -0.4	15849.00	-8.5	-8.55	0.12	-0.05	+1.0, -7.4
398.11	0.0	0.01	0.10	0.00	+0.4, -0.4	19953.00	-11.2	-11.29	0.12	-0.09	+1.0, -8.7

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Sound Level Meter Model: 824 Serial Number: A1556
Certificate of Flat-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dB SPL. The instrument's Flat-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance	Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-6.0	-6.16	0.10	-0.16	+1.8, -1.8	501.19	0.0	-0.03	0.10	-0.03	+0.4, -0.4
12.59	-4.2	-4.35	0.10	-0.15	+1.5, -1.5	630.96	0.0	0.00	0.10	0.00	+0.4, -0.4
15.85	-2.9	-3.01	0.10	-0.11	+1.2, -1.2	794.33	0.0	0.00	0.10	0.00	+0.4, -0.4
19.95	-1.9	-2.04	0.10	-0.14	+1.0, -1.0	1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
25.12	-1.3	-1.31	0.10	0.00	+0.9, -0.9	1258.90	0.0	0.00	0.10	0.00	+0.4, -0.4
31.62	-0.8	-0.86	0.10	-0.06	+0.7, -0.7	1584.90	0.0	0.00	0.10	0.00	+0.4, -0.4
39.81	-0.5	-0.57	0.10	-0.07	+0.7, -0.7	1995.30	0.0	-0.03	0.10	-0.03	+0.4, -0.4
50.12	-0.3	-0.37	0.10	-0.07	+0.5, -0.5	2511.90	0.0	-0.03	0.10	-0.03	+0.4, -0.4
63.10	-0.2	-0.23	0.10	-0.03	+0.5, -0.5	3162.30	0.0	0.00	0.10	0.00	+0.4, -0.4
79.43	-0.1	-0.16	0.10	-0.06	+0.5, -0.5	3981.10	0.0	-0.03	0.10	-0.03	+0.4, -0.4
100.00	-0.1	-0.11	0.10	-0.01	+0.5, -0.5	5011.90	0.0	0.00	0.10	0.00	+0.5, -0.5
125.89	0.0	-0.07	0.10	-0.07	+0.5, -0.5	6309.60	0.0	-0.03	0.10	-0.03	+0.5, -0.7
158.49	0.0	-0.05	0.10	-0.05	+0.5, -0.5	7943.30	0.0	0.00	0.10	0.00	+0.5, -1.0
199.53	0.0	-0.04	0.10	-0.04	+0.5, -0.5	10000.00	0.0	0.00	0.12	0.00	+0.7, -1.3
251.19	0.0	-0.03	0.10	-0.03	+0.5, -0.5	12589.00	0.0	-0.03	0.12	-0.03	+1.0, -2.0
316.23	0.0	-0.03	0.10	-0.03	+0.4, -0.4	15849.00	0.0	-0.03	0.12	-0.03	+1.0, -7.4
398.11	0.0	-0.03	0.10	-0.03	+0.4, -0.4	19953.00	0.0	-0.03	0.12	-0.03	+1.0, -8.7

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Sound Level Meter Model: 824 Serial Number: A1556
Summary Test Data

dB Offset (added to dBuV readings for dBSPL): 1.0
NoiseFloor: 7.8 (8.8 SPL)
LogLin Reference: 113.0 (114.0 SPL)
Weighted Peak Reference: 116.0 (117.0 SPL)
Overload: 127.2 (128.2 SPL)
LowerRange (max (noisefloor, w/in limits, w/in diff linearity)): 18.0 (19.0 SPL)
UpperRange (min (overload, w/in limits, w/in diff linearity)): 127.1 (128.1 SPL)
UpperLimit (Overload - 0.1): 127.1 (128.1 SPL)
Primary indicator range: 109.1 dB (Minimum Allowed: 105.0)
Dynamic range: 119.3 dB (Minimum Allowed: 110.0)
Gain stages measured at input level 70.00 dBuV:
Gain + 0 reference: 69.98
Gain + 10, Value: 69.96, Error: -0.02, Passed
Gain + 20, Value: 70.02, Error: 0.04, Passed
Gain + 30, Value: 69.99, Error: 0.01, Passed
Gain + 40, Value: 70.01, Error: 0.03, Passed
Gain + 50, Value: 69.98, Error: 0.00, Passed

LogLin Test Run Date: Tue Mar 04 12:22:21 2014. Passed
A Weight Test Run Date: Tue Mar 04 12:36:07 2014. Passed
C Weight Test Run Date: Tue Mar 04 12:38:08 2014. Passed
F Weight Test Run Date: Tue Mar 04 12:39:55 2014. Passed
Crest Test Run Date: Tue Mar 04 13:12:39 2014. Passed
Burst Test Run Date: Tue Mar 04 13:17:45 2014. Passed
Detector Test Run Date: Tue Mar 04 13:21:18 2014. Passed
Frequency Counter Test Run Date: Tue Mar 04 13:26:07 2014. Passed

This 824 has the following purchased options:
Logging SLM -

Certificate of Calibration and Conformance

Certificate Number 2014-187224

Instrument Model PRM902, Serial Number 2072, was calibrated on 4 Mar 2014. The instrument meets factory specifications per Procedure D0001.8126.

Instrument found to be in calibration as received: YES

Date Calibrated: 4 Mar 2014

Calibration due: 4 Mar 2016

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Hewlett Packard	34401A	US36033460	12 Months	1 Jul 2014	6141807
Larson Davis	LDSigGn/2209	0617 / 0104	12 Months	17 Jan 2015	2014-185086

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 23 ° Centigrade

Relative Humidity: 28 %


Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"As received" data is the same as shipped data.

Signed: 
Technician: Sean Childs

Certificate of Calibration and Conformance

Certificate Number 2014-187224

Instrument Model PRM902, Serial Number 2072, was calibrated on 4 Mar 2014. The instrument meets factory specifications per Procedure D0001.8126.

Instrument found to be in calibration as received: YES

Date Calibrated: 4 Mar 2014

Calibration due: 4 Mar 2015

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Hewlett Packard	34401A	US36033460	12 Months	1 Jul 2014	6141807
Larson Davis	LD500Gn/2209	0617 / 0104	12 Months	17 Jan 2015	2014-185086

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 23 ° Centigrade

Relative Humidity: 28 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

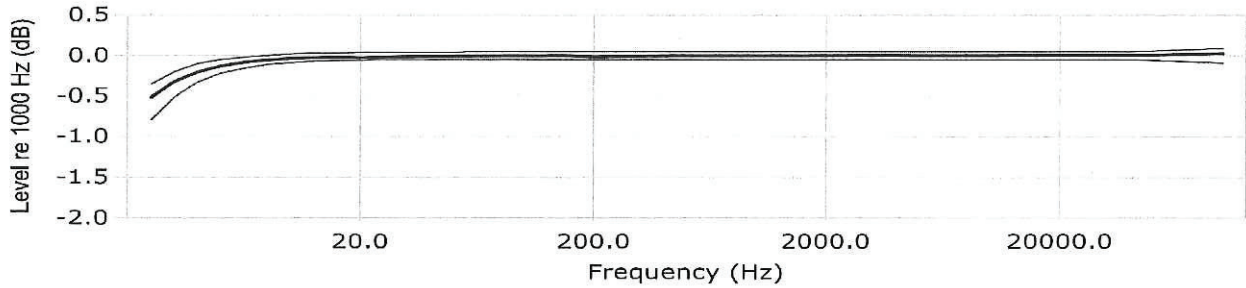
"As received" data is the same as shipped data.

Signed: 
Technician: Sean Childs



**Preamplifier Model: PRM902 Serial Number: 2072
Frequency Response Test Report**

Frequency response electrically tested at 120.0 dB μ V using a 18 pF capacitor to simulate microphone capacitance.



Frequency (Hz)	Relative Level (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Relative Level (dB)	Uncertainty (dB)	Limits (dB)
2.5	-0.51	0.08	-0.35,-0.79	631.0	-0.00	0.02	0.05,-0.05
3.2	-0.32	0.06	-0.20,-0.51	794.3	-0.00	0.02	0.05,-0.05
4.0	-0.21	0.06	-0.10,-0.33	1000.0	0.00	0.02	0.05,-0.05
5.0	-0.13	0.04	-0.05,-0.22	1258.9	0.00	0.02	0.05,-0.05
6.3	-0.08	0.04	-0.02,-0.16	1584.9	0.00	0.02	0.05,-0.05
7.9	-0.05	0.04	0.00,-0.11	1995.3	0.00	0.02	0.05,-0.05
10.0	-0.04	0.02	0.02,-0.09	2511.9	0.00	0.02	0.05,-0.05
12.6	-0.03	0.02	0.03,-0.07	3162.3	0.00	0.02	0.05,-0.05
15.8	-0.02	0.02	0.03,-0.06	3981.1	0.00	0.02	0.05,-0.05
20.0	-0.03	0.02	0.04,-0.06	5011.9	0.00	0.02	0.05,-0.05
25.1	-0.02	0.02	0.04,-0.05	6309.6	0.00	0.02	0.05,-0.05
31.6	-0.01	0.02	0.04,-0.05	7943.3	0.00	0.02	0.05,-0.05
39.8	-0.01	0.02	0.04,-0.05	10000.0	0.00	0.02	0.05,-0.05
50.1	-0.01	0.02	0.04,-0.05	12589.3	0.00	0.02	0.05,-0.05
63.1	-0.01	0.02	0.05,-0.05	15848.9	0.00	0.02	0.05,-0.05
79.4	-0.01	0.02	0.05,-0.05	19952.6	0.01	0.02	0.05,-0.05
100.0	-0.00	0.02	0.05,-0.05	25118.9	0.01	0.02	0.05,-0.05
125.9	-0.00	0.02	0.05,-0.05	31622.8	0.01	0.02	0.05,-0.05
158.5	-0.00	0.02	0.05,-0.05	39810.7	0.01	0.02	0.05,-0.05
199.5	-0.01	0.02	0.05,-0.05	50118.7	0.01	0.02	0.06,-0.06
251.2	-0.01	0.02	0.05,-0.05	63095.7	0.01	0.05	0.07,-0.07
316.2	-0.01	0.02	0.05,-0.05	79432.8	0.02	0.05	0.08,-0.08
398.1	-0.00	0.02	0.05,-0.05	100000.0	0.03	0.05	0.09,-0.09
501.2	-0.00	0.02	0.05,-0.05				

1000 Hz measured level: 119.806 dB μ V, -0.194 dB re input (0.033 dB uncertainty; -0.278 dB to 0.008 dB limit)

1 kHz (1/3 Octave) Noise Floor : 0.33 μ V, -9.50 dB μ V (0.47 dB uncertainty; -4.00 dB limit)

Flat (20 Hz - 20 kHz) Noise Floor : 4.93 μ V, 13.86 dB μ V (0.47 dB uncertainty; 15.00 dB limit)

A-weight Noise Floor : 1.78 μ V, 5.00 dB μ V (0.46 dB uncertainty; 10.00 dB limit)

Environmental conditions: 22.8 °C, 30.0 %RH (0.3 °C, 3 %RH uncertainty)

Uncertainties are given as expanded uncertainty at ~95 percent confidence level (k = 2).

Test Procedure: D0001.8126 with PRM902 (SMD).xml

This frequency response is in compliance with manufacturers specification for the item tested.

This report may not be reproduced, except in full, without the written approval of the issuer.

Technician: Sean Childs

Test Date: 04 Mar 2014 10:37:22

Test Location: Larson Davis, a division of PCB Piezotronics, Inc.
1681 West 820 North, Provo, Utah 84601
Tel: 716 684-0001 www.LarsonDavis.com

APPENDIX D

Table D1 - Summary of Measurement Conditions

Goshen Wind Farm, 1500886

Measurement Date	21/05/2015
Wind Speed	3 to 4 m/s (gusting to 5 m/s)
Temperature	13°C
Relative Humidity	70 %

APPENDIX E

Table E1 - Measured Goshen Transformer ONAN Sound Pressure Levels

Goshen Wind Farm, 1500886

Position of Measurement	1/3 Height	2/3 Height
	(dBA)	(dBA)
1	65	63
2	70	64
3	68	68
4	70	64
5	68	66
6	64	63
7	64	63
8	67	66
9	63	63
10	68	65
11	72	69
12	68	62
13	66	61
14	67	68
15	66	61
16	66	61
17	60	62
18	68	65
19	67	63
20	66	64
21	67	62
22	62	59
23	64	63
24	66	61
25	64	60
26	63	66
27	69	68

Goshen ONAN**Transformer Audit Dimensions**

Height	4.1 m
Perimeter	26 m
Top Area	33.8 m ²
Surface Area	140.4 m ²

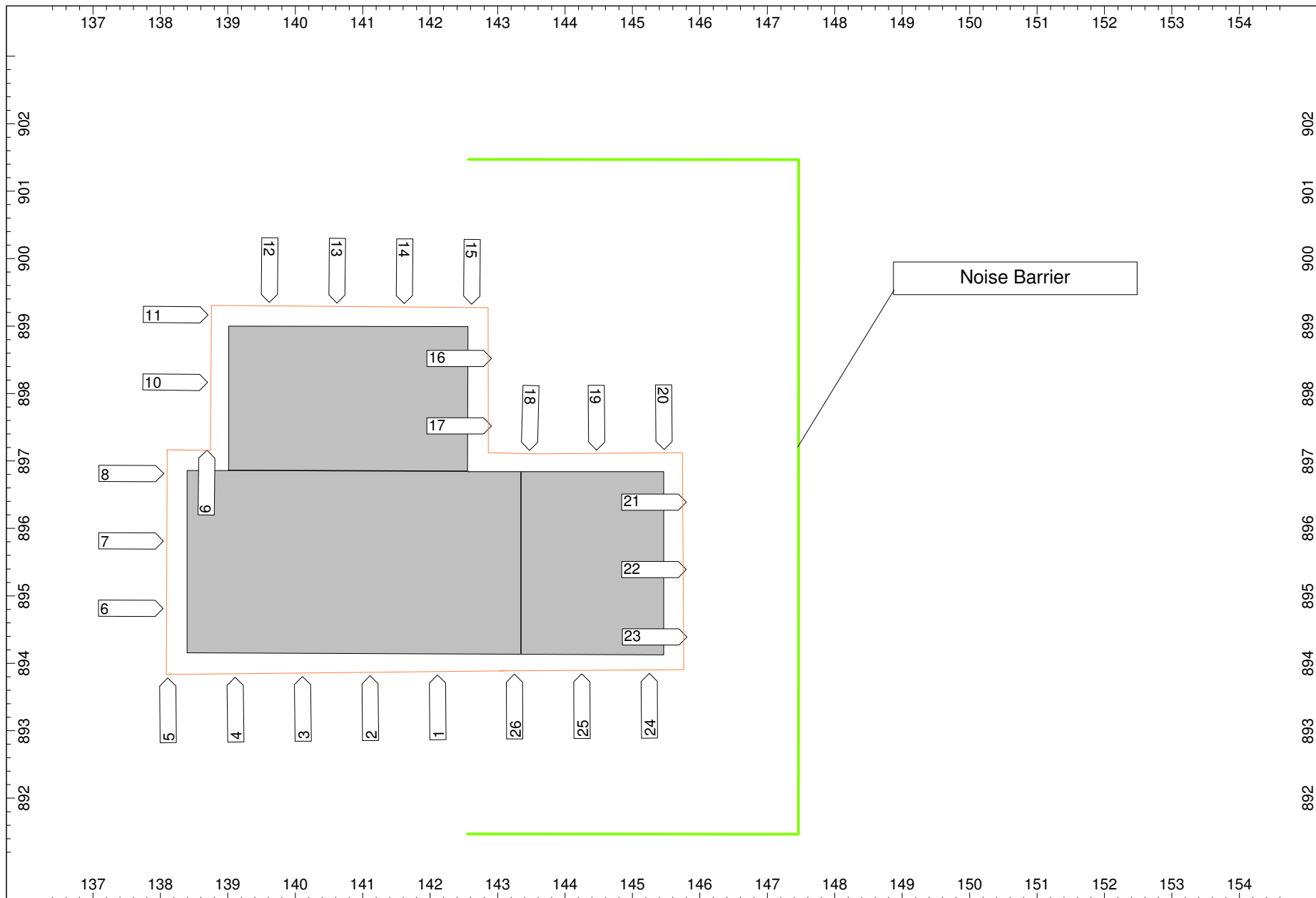
Table E2 - Measured Goshen Transformer ONAF Sound Pressure Levels

Goshen Wind Farm, 1500886

Position of Measurement	1/3 Height	2/3 Height
	(dBA)	(dBA)
1	69	69
2	72	69
3	68	69
4	71	68
5	69	67
6	67	65
7	65	66
8	71	68
9	69	69
10	73	72
11	74	72
12	71	72
13	71	73
14	71	71
15	71	72
16	71	72
17	73	73
18	73	74
19	74	75
20	74	75
21	73	74
22	72	73
23	72	73
24	71	72
25	72	73
26	71	71
27	70	70
28	71	70
29	72	72

Goshen ONAF**Transformer Audit Dimensions**

Height	4.1 m
Perimeter	28 m
Top Area	46.8 m ²
Surface Area	161.6 m ²



Noise Barrier

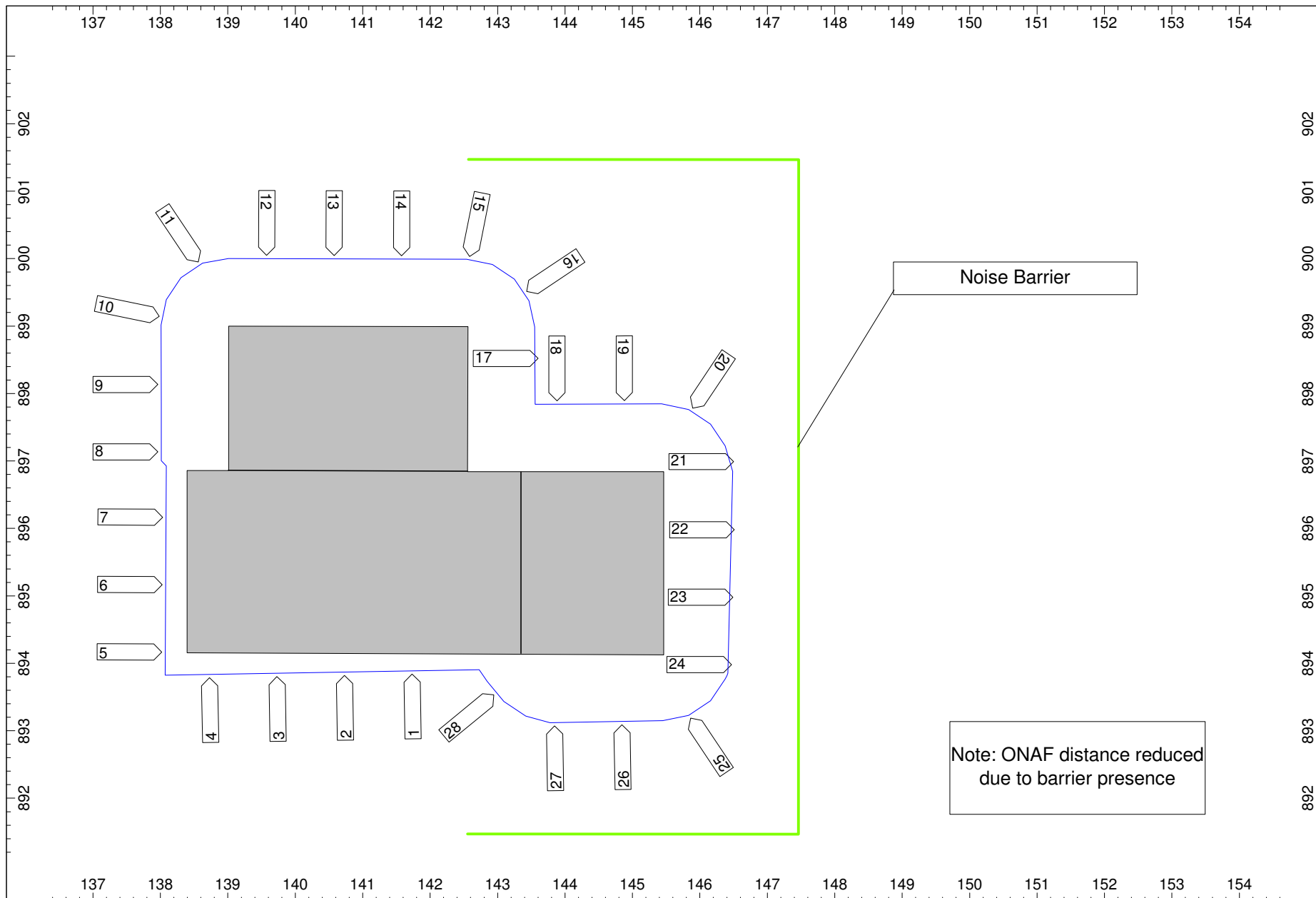
Goshen Transformer Measurement Locations
ONAN Conditions

Goshen Wind Energy Centre

Drawn by: AKH	Units: m
Scale:	1:80
Date:	Mar 30, 2016

Project #1500886





Goshen Transformer Measurement Locations
ONAF Conditions

Goshen Wind Energy Centre

Drawn by: AKH	Units: m
Scale:	1:80
Date:	Mar 30, 2016

Project #1500886

